

Cherry Point

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

Prepared for

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EXECUTIVE SUMMARY

INTRODUCTION AND OBJECTIVES

The Washington State Department of Natural Resources (WDNR) is responsible for managing the state's 2.4 million acres of aquatic lands for all people of Washington. In this role as a trustee, WDNR manages the leasing of state tidelands. Earlier this year, WDNR reached terms with ARCO Products Company (ARCO) for a new 30-year lease of state aquatic lands for their Cherry Point refinery, located in the northern Puget Sound area along the Strait of Georgia. In addition to reauthorizing ARCO's existing pier, which extends 655 m (2,150 ft) from shore, the lease outlines the environmental studies that must be conducted so that WDNR can evaluate ARCO's request to build an addition to its existing pier to increase the efficiency of loading and unloading activities. Expansion of facilities and operations along Cherry Point are being carefully evaluated to determine whether these actions may adversely impact the Cherry Point Pacific herring stock, which spawns in tidal waters from mid-March to June.

Pacific herring are an important component of the diet for many finfish, marine mammal, and sea bird populations of the Georgia Basin, Puget Sound, and nearby coastal waters. The Cherry Point herring stock, historically the largest of the 18 identified stocks in the Georgia Basin-Puget Sound area, has been declining since the 1970s. Over the last 26 years, this stock has declined by 91 percent, from a high of 14,998 tons in 1973 to a low of 1,322 tons in 1998. The large decline of this important herring stock led WDNR to commission this screening level ecological risk assessment, to identify and evaluate the natural and anthropogenic factors, or "stressors," that may have contributed to the decline of this stock, and to assess what impact an extension to ARCO's existing pier might have on the stock. There were 4 specific objectives of this study:

1. Identify all stressors that may be contributing to the observed decline in the Cherry Point herring stock and the pathways by which they act, and analyze available data to determine the importance of each.
2. Screen out stressors that can be considered unimportant based on existing data, and retain stressors for which either (a) data do not exist or are highly uncertain, or (b) data suggest that the stressor may affect the stock.
3. For stressors that are retained, evaluate the potential contribution of each to the declining trend in the Cherry Point herring stock, and the potential influence of human activities regarding that stressor.
4. Specifically assess the potential influence on the stock of the proposed ARCO pier extension.

ASSESSMENT METHODS

The U.S. Environmental Protection Agency risk assessment methodology was used as the framework for identifying and evaluating the influence of all factors and conditions that could be contributing to the decline of the Cherry Point herring stock. These stressors were identified during a 2-day workshop with regional experts and stakeholders held on March 23rd and 24th, 1999, which was supported by a thorough review of existing literature. Potential sources of data relating to each stressor were also identified during the workshop and literature review. The information gathered in this process was used to develop a conceptual model to show which stressors could affect the stock, and the pathways by which each stressor might operate.

Each stressor and pathway was analyzed using a weight-of-evidence approach that considered all available data (Figure 1). Where there was adequate information, the conventional risk assessment approach was used: current and predicted future levels of a stressor were compared to levels for which effects were known. This analysis was augmented with an analysis of trends. Trends in stressor levels were compared with trends in herring stock characteristics, such as health (condition), size of the stock (biomass), and the total weight of two- and three-year-old first-time spawners (recruitment biomass). Trends in the Cherry Point herring stock were then also compared to trends in other stocks to help determine which stressors are likely, and which are not likely, to have influenced trends in the Cherry Point stock. The weight given to stressors and pathways in the overall assessment depended on the amount and quality of data available. For many pathways, potentially useful analyses were not possible because of poor or inadequate data.

RESULTS AND DISCUSSION

The array of stressors identified by workshop participants as potentially related to the decline in the Cherry Point herring stock biomass were evaluated using existing information. To assist WDNR in making management decisions, the stressors have been rated as to whether they were more or less likely contributors to the decline. Some stressors have been screened out as being highly unlikely contributors to the stock decline, some have been screened in as likely contributors and rated as to the probable magnitude of impact, and some have been screened in because data were insufficient and more study is required.

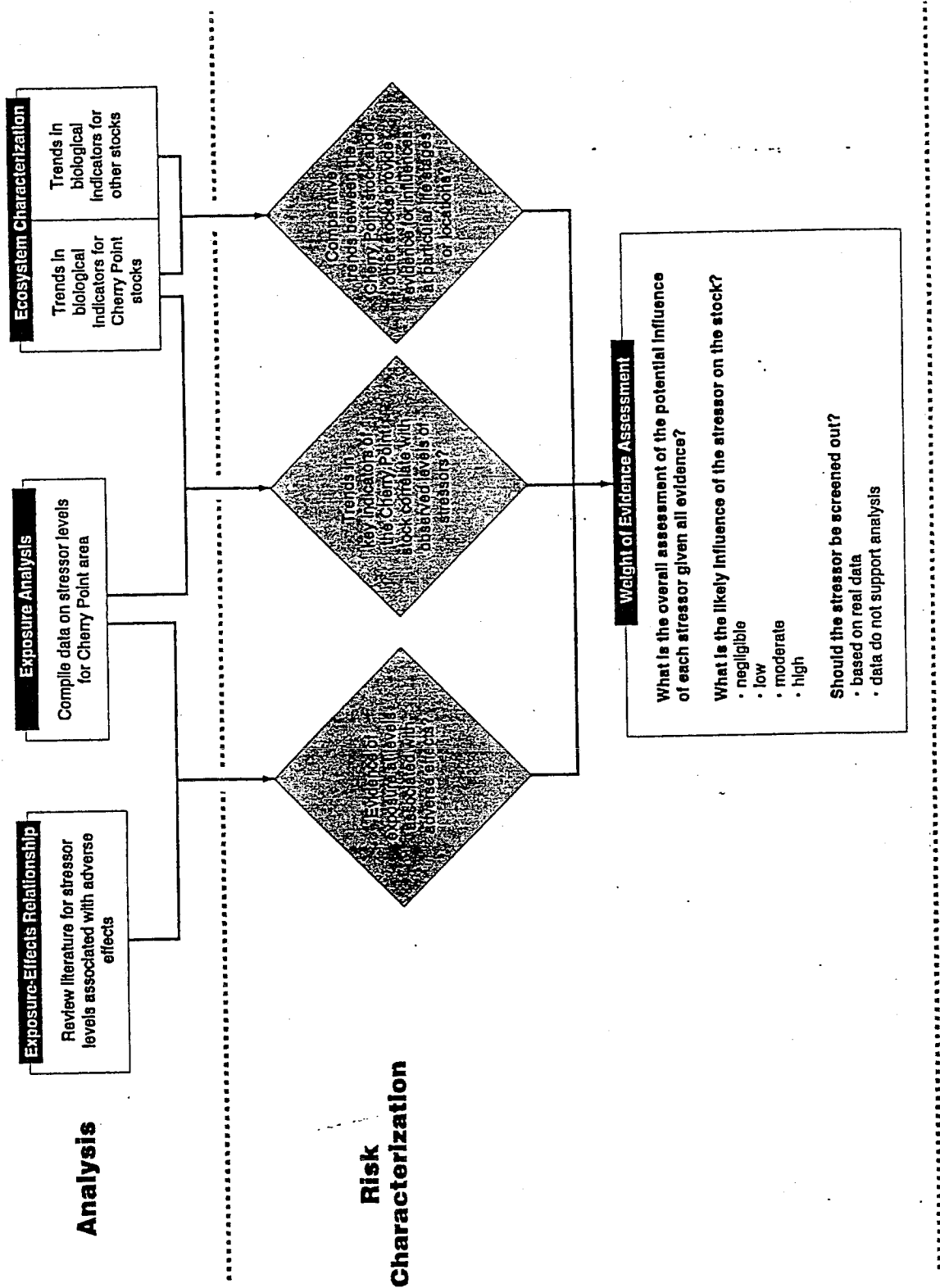


Figure ES-1. Approach for analysis and risk characterization of individual stressors.





Results of the screening level risk assessment are summarized in Figures 2 and 3, and discussed in greater detail in the following three subsections. The first of these subsections discusses the decline of the Cherry Point herring stock in general, and the most likely stressors involved. The second subsection discusses possible human influences on that decline. The third subsection discusses in detail the potential impact of the proposed ARCO pier extension on the herring stock. Findings regarding each stressor, both in general and in relation to the proposed ARCO pier extension, are outlined in detail in Table 1, which follows the text.




Figure 2 shows the predicted magnitude of impact of each stressor on the Cherry Point herring stock. The upper part of this figure addresses the impact of stressors on the stock in general, and the lower part of the figure addresses how the proposed ARCO pier extension may effect stressors, and through them the Cherry Point herring stock. Figure 3 defines the terms used to characterize predicted stressor impact: high, moderate, low, negligible to low, negligible, and screened out.

Possible Explanations for the Decline in Biomass

The available data indicate that trends in the Cherry Point stock are likely due primarily, but not necessarily entirely, to increased mortality of adults. This increased mortality may be due to one or more of the following: changes in ocean conditions, particularly sea surface temperature, that appear to have led to increased predation by Pacific hake off southern Vancouver Island; changes in competition or food supply, also associated with trends in ocean conditions; and increased local predation on spawning adults by seals or other species. There are several lines of evidence to support the idea that the decline is due to effects on adults—effects that probably occur offshore:

- The proportion of the spawning biomass composed of older fish has declined, and the three oldest age classes—herring aged 7, 8, and 9 years—have disappeared, indicating increasing mortality of adults.
- Mortality due to fishing has declined over time, so increased mortality among older fish must be the result of other stressors. Although the initial decline in stock biomass in the late 1970s and early 1980s may have been due to high annual harvests, harvests did not play a role in the declines of the 1980s and 1990s. The time elapsed since the harvest rate was reduced to sustainable levels is greater than the oldest recorded age class in the population.
- Recruitment biomass, i.e., the number of 2- and 3-year-old spawners, has not declined, which may indicate that the primary cause of the decline in stock biomass does not result from local effects on early life stages at Cherry Point.

Stressor	Life Stages			
	Eggs/Embryo 	Larvae 	Juvenile 	Adults Migratory Spawning 
PHYSICAL STRESSORS				
Temperature	M	M	M	N-L
Salinity	L	L		
Dissolved Oxygen	X			
Storms and weather patterns				
ECOLOGICAL STRESSORS				
Lack of Vegetation/Substrate	N-L	N-L	N-L	N-L
Food Supply		M	M	M
Disease	L	L	L	L
Predation	L	L	M	H
ANTHROPOGENIC STRESSORS				
Fishing	L		L	L
Wave Sheltering	N-L	N-L		N-L
Light Shading	N	N	N	N
Vessel Traffic		N		N-L
Ship Disturbance	N	N		N
Ship Ballast		N-L		
Upland Noise		X		X
Contaminants				
Inorganic	X	X		X
Organic	M	M		M
Turbidity and Suspended Solids	N	L		

ARCO Pier Extension			
Stressor	Life Stages		
	Eggs/Embryo 	Larvae 	Spawning Adults 
PHYSICAL STRESSORS			
Lack of Vegetation/Substrate	N	N	N
Food Supply		X	
Disease		X	X
Predation	X	X	N
ECOLOGICAL STRESSORS			
Wave Sheltering	N-L	N	N
Light Shading	X	M	X
Vessel Traffic		N	N-L
Ship Disturbance	N	N	N
Ship Ballast		N-L	
Upland Noise		X	X
Contaminants			
Inorganic	X	X	X
Organic	N	N	N
Turbidity and Suspended Solids	N	M	

H	High	M	Moderate	L	Low	N-L	Negligible to Low
N	Negligible	X	Screened out	Blank	Not identified as a stressor		

* These ratings address only the impacts of minor spills, and assume that ARCO will maintain the same safety record with increased traffic. Ratings do not address the possibility of a catastrophic oil spill in the area, which could have a catastrophic impact on the herring stock.

Figure ES-2. Stressors and predicted impacts

H**HIGH EFFECT**

- Within threshold of effects cited in the scientific literature, and
 - Statistically significant correlation exists between the stressor and spawning biomass or rate of mortality.
- OR
- Threshold of effects unknown, and
 - Best professional judgement suggests that the temporal change of the stressor is one of the most likely explanations for the stock decline and change in age class structure.

M**MODERATE EFFECT**

- Within threshold of effects in the scientific literature, and
 - Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998). However, best professional judgement suggests that the stressor may have a high potential to adversely impact individuals of a given life stage.
- OR
- Threshold of effects unknown, and
 - Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998). However, best professional judgement suggests that the stressor may have a high potential to adversely impact individuals of a given life stage.

L**LOW EFFECT**

- Within threshold of effects in the scientific literature, and
 - Limited amount of data, and
 - Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998). However, best professional judgement suggests that the stressor may adversely impact individuals of a given life stage.
- OR
- Threshold of effects unknown, and
 - Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998). However, best professional judgement suggests that the stressor may adversely impact individuals of a given life stage.

N-L**NEGLECTIBLE to LOW EFFECT**

- Limited amount of data, and
- Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998), and
- Available data suggests that herring respond to the stressor, but uncertainty exists as to whether the stressor adversely affects the survival of individuals and/or spawning success of the stock

N**NEGLECTIBLE EFFECT**

- Limited amount of data, and
- Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998), and
- Best professional judgement suggests that the stressor is unlikely to adversely impact the survival of individuals and/or spawning success of the stock.

X**SCREENED OUT**

- Sufficient data to evaluate stressor impacts, and
- Below threshold levels observed in the scientific literature, and
- Temporal trend in the stressor does not explain the observed change in the age class structure of the stock (1973-1998).

Figure ES-3. Definitions of effects categories

- This finding must be interpreted with caution because it is also possible that average age-at-maturity is decreasing and masking a true decline in the number of 2 and 3 year olds in the population, i.e., that the number of 2- and 3-year-old spawners has decreased, but a greater proportion of them have successfully spawned.
- There are several indications that the Cherry Point stock is a migratory population that spends its summer and winter on or near the continental shelf off southern Vancouver Island, and then migrates to its spawning grounds in the southern Strait of Georgia through the Strait of Juan de Fuca. This is important because there is considerable evidence that the trend in the biomass of herring for the British Columbia stock that utilizes the continental shelf off southern Vancouver Island is correlated with sea surface temperature, which is driven by broad oceanographic conditions. In contrast, most other stocks in the Puget Sound area appear to be resident and therefore are not affected by conditions off southern Vancouver Island.
- There are several plausible mechanisms by which broad oceanographic conditions could influence herring off southern Vancouver Island. One possible mechanism that may partially explain the decline in adult herring is increased predation by Pacific hake. Pacific hake migration into the area increases as surface water temperatures rise, and the hake population becomes sufficiently large to cause high mortality rates in adult herring. There is solid empirical evidence of correlations among herring biomass, temperature, and hake biomass. Other mechanisms linked to oceanographic conditions, such as the abundance of other predators or competitors, may also influence trends in the Cherry Point herring stock, but have not been studied as much to date.
- The abundance in the Puget Sound area of seals and some other predators known to target herring has increased significantly.
- Many other stressors that could offer alternative explanations for the decline of the stock act on early life stages near Cherry Point. However, the increased mortality on adults and the lack of a trend in recruitment indicate that the stressor driving the decline is not acting on the early life stages; this suggests that local stressors are not the principal cause of the stock's decline.

In summary, a likely trend of increasing predation, and possibly other trends, all of which are likely linked to broad oceanographic conditions, are resulting in increased mortality of the largest and oldest herring in the Cherry Point stock. These trends appear to account for much of the decline in stock biomass of Cherry Point herring, explaining both the loss

of the oldest age classes and the increase in natural mortality of Cherry Point herring during the 1973 to 1998 period.

Incremental Effects of All Stressors and Human Activities

The Cherry Point herring stock has reached a historically low level of abundance. If the declining trend in biomass continues, the viability of the stock may be threatened. Consequently, although the primary cause of the decline may be linked to broad oceanographic conditions, the incremental influences of other stressors may have important cumulative effects on the stock. The potential contribution of each stressor of potential concern to the decline of the Cherry Point herring stock was evaluated based on the weight of evidence from all available information. The findings are summarized in Table 1. Almost every stressor is screened in based on existing information, because all of the stressors have the potential to exert some effect on the stock. The likely contribution of most individual stressors to the decline in the stock is negligible to low. However, it is difficult to assess the potential cumulative effects of stressors, given the available data. The likely contribution of human activities to the decline in the stock via particular stressors is negligible to low for most stressors.

Predicted Risks From the Proposed ARCO Pier Extension

The proposed ARCO pier extension is of immediate interest to WDNR. The review of stressors and specific pathways indicates that there are only a few mechanisms by which the proposed extension itself could conceivably affect the herring stock. Conclusions regarding individual stressors and pathways are summarized below; individual stressors are also addressed in Table 1.

Physical Stressors

There are no potential influences of the ARCO pier extension on the physical stressors that have been evaluated in this screening risk characterization (temperature, salinity, dissolved oxygen, and storms). The proposed pier extension is more than 700 m (2,300 ft) offshore in 20 m (65 ft) of water, so would not be expected to influence water temperatures or the effects of storms on nearshore beach habitats used by spawning herring. The proposed extension does not include substantial additional discharges of fresh water, nutrients, or other inputs that could change the salinity or level of dissolved oxygen in the water.

Biological Stressors

The potential influences of the pier extension on biological stressors are none to negligible, primarily because of its distance from shore. The extension is not located in vegetated zones of subtidal areas, so would not affect the vegetation patterns associated with spawning herring. The extension could provide potential refuge for local predators, but this possible mechanism would be minimized because of the relatively small area of the extension and the distance from nearshore spawning areas. In addition, the industrial nature and activities associated with the pier would not make it an attractive refuge for marine mammal predators. There is no evidence that such structures are associated with spreading diseases or influencing prey supply.

Anthropogenic Stressors

Vessel traffic and ship ballast are anthropogenic stressors associated with the ARCO pier extension that have the largest potential to impact the Cherry Point herring stock. Vessel traffic is expected to increase over the next four years—from 249 vessels per year in 1998 to an estimated 330 vessels per year in 2002—regardless of whether or not the pier extension is built (Payne pers. comm. 1999e). Of particular concern for the risk assessment is vessel activity in the Cherry Point region during herring spawning months of March through June. During spawning months, traffic is predicted to increase 18 percent over the next five years; this increase is estimated by comparing the 5-year projected estimate of 103 vessels per spawning season to the highest historical value of 87 vessels per spawning season in 1987 (Payne pers. comm. 1999b). Using an alternative analysis, vessel traffic will increase as much as 36 percent during spawning months; this increase is estimated by comparing the 5-year projected estimate to the average traffic rate for the last 17 years.

The proposed pier extension is intended to increase the efficiency of unloading crude and product carriers at the dock by creating a separate dock for product carriers to unload. Currently, crude and product carriers share a dock and only one vessel may be loaded or unloaded at a time. Whereas ARCO indicates that the projected increase in vessel activity will not exceed the capacity of the existing pier over the next four years (Payne pers. comm. 1999e), it is assumed that the additional pier would facilitate handling of the increased activity. In addition, no information is available on vessel traffic projections after four years, except the 5-year projection for vessel traffic during spawning months. After this time, it is assumed that the pier extension would support additional increases in vessel traffic to the refinery. In summary, because information is not available that distinguishes between vessel traffic associated with the existing and the proposed piers, impacts from vessel traffic were analyzed regardless of the capacity of the existing pier.

Current shipping lanes to the ARCO refinery cross the edge of herring pre-spawn holding areas and may elicit avoidance responses by herring to the vessel-generated noise.

Acoustic surveys indicate that pre-spawn herring hold near the bottom in waters 35–40 m (115–120 ft) deep so the level of impact would not likely be substantial. However, fish eventually move into shallower waters as they migrate shoreward to spawn and may move from this depth during feeding periods. Therefore, critical time periods may occur when noise levels impact spawning and/or feeding behavior.

Ballast water uptake by vessels at the dock will increase with the expected increase in vessel traffic. Herring larvae mortality rates in the vicinity may be directly impacted when larvae are taken up with ballast water. While the impact of this activity on larvae is not known, it is estimated that a tanker can take up to 10,000,000 gallons or 1,300,000 ft³ of water for ballast. In addition, exotic species may be transported to the area and released, potentially impacting herring. Therefore, both vessel traffic and ship ballast are predicted to have a negligible to low impact on the Cherry Point herring stock.

The projected increase in ship traffic at the existing ARCO pier and the proposed extension increases the probability of minor oil and product spills. Even if ARCO were to maintain the same record of safety compliance, the increased traffic would likely increase risk.

There has never been a catastrophic oil spill in this area. However, if such a spill were to occur, especially during or just before the herring spawning and rearing season, the impact to the Cherry Point herring stock could be catastrophic.

The potential influences of the pier extension on the remaining anthropogenic stressors are negligible, primarily because of the project's distance from nearshore spawning activities.

- Fishing or activities associated with commercial harvesting will not occur at the pier.
- Wave sheltering is expected to be negligible. The proposed pier is expected to have a similar or lesser effect on wave sheltering than the existing structure. Data on wave sheltering were limited to an assessment conducted for another proposed pier, Gateway International Terminal, which also estimated negligible effects. The proposed pier extension structure is comparatively farther from shore and would be constructed in a more transparent manner than the proposed Gateway pier.

- The proposed pier extension is not expected to cause light shading that would influence herring because the structure would be beyond the vegetated zone associated with spawning.
- The potential influence of the pier extension on noise and turbidity is expected to be negligible. Short-term effects associated with the noise and turbidity generated by pile driving and other activities would likely occur during the construction of the pier.
- The potential influence of the pier extension on contaminant inputs is expected to be negligible. There are possible short-term effects associated with discharges and resuspension of sediment during construction activities.

Oil Spills

The projected increase in ship traffic at the ARCO pier that is expected to occur (see above discussion) increases the probability of minor oil and product spillage. Even if ARCO were to maintain the same record of safety compliance, the increased traffic would likely increase risk of this kind of minor, non-catastrophic spill.

There has never been a catastrophic oil spill in this area, and the likelihood of a catastrophic spill cannot be predicted. However, if such a spill were to occur, especially during or just before the herring spawning and rearing season, the impact to the Cherry Point herring stock could be catastrophic. The ratings given for the risk from organic contaminants do not reflect this unquantifiable risk, but it must be noted that increasing ship traffic will inevitably increase the risk of an oil spill.

Table ES-1. Summary of screening assessment for individual stressors and pathways contributing to trends in the Cherry Point herring stock

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, negligible to low, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)
Temperature	Eggs and larvae	<p>Screened In</p> <ul style="list-style-type: none"> Observed temperatures have exceeded the screening threshold 	<p>Moderate</p> <ul style="list-style-type: none"> No correlation with recruitment Exceedances of benchmarks Evidence that stock decline due to effects on adults 	<p>None</p> <ul style="list-style-type: none"> No evidence for increased temperatures in study area compared to the Strait of Georgia 	<p>None</p> <ul style="list-style-type: none"> No evidence for increased temperatures in study area compared to the Strait of Georgia
	Juveniles and 2-year-old adults	<p>Screened In</p> <ul style="list-style-type: none"> Correlation between regional sea surface temperatures and spawning biomass Correlation between regional sea surface temperatures and mortality 	<p>Moderate</p> <ul style="list-style-type: none"> Recruitment of first year spawners relatively constant from 1977-1994 Possible downward trend in recruitment from 1995-1998 	<p>None</p> <ul style="list-style-type: none"> Local/regional human activities have not caused increased sea surface temperatures Human activities on global scale potentially affect sea surface temperatures Increased sea surface temperatures attributed to PDO 	<p>None</p> <ul style="list-style-type: none"> Cherry Point herring are a migratory stock beginning with juvenile life stage—not in local area No evidence for increased temperatures in study area compared to the Strait of Georgia
Spawning adults		<p>Screened In</p> <ul style="list-style-type: none"> No evidence of adult mortality in the study area during the spawning period Egg and larval stages most sensitive; no correlation between temperature and recruitment Possible downward trend in recruitment in recent years 	<p>Negligible</p> <ul style="list-style-type: none"> Evidence to indicate that temperature-related declines are occurring in offshore areas 	<p>None</p> <ul style="list-style-type: none"> Evidence to indicate that temperature-related declines are occurring in offshore areas No evidence of local human activities causing increases in temperature 	<p>None</p> <ul style="list-style-type: none"> Evidence to indicate that temperature-related declines are occurring in offshore areas No evidence that the pier extension will cause increases in temperature
		<p>Screened In</p> <ul style="list-style-type: none"> Correlation between regional sea surface temperatures and spawning biomass Correlation between regional sea surface temperatures and mortality Substantial decrease in the population of repeat spawners 	<p>High</p> <ul style="list-style-type: none"> Highly significant correlations between sea surface temperature and stock indices Observed minima in spawning biomass during El Niño years Documented observations of increased numbers of warm-water predators 	<p>None</p> <ul style="list-style-type: none"> Local/regional human activities have not caused increased sea surface temperatures Increased sea surface temperatures attributed to PDO 	<p>None</p> <ul style="list-style-type: none"> Cherry Point herring are a migratory stock beginning with juvenile life stage—not in local area No evidence for increased temperatures in study area compared to the Strait of Georgia

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, low, moderate, high)
Salinity	Eggs and larvae	<p>Screened In</p> <ul style="list-style-type: none"> Salinities at monitoring stations within 16 km (10 mi) of the study area are near the thresholds of tolerance levels Lack of data in the immediate study area <p>Screened out</p> <ul style="list-style-type: none"> Regional DO concentrations are above thresholds of effects No evidence that industrial inputs affect DO concentrations in the study area No correlation between DO and herring recruitment 	<p>Low</p> <ul style="list-style-type: none"> Regional salinities, while in the thresholds of tolerance levels, are not associated with substantial mortality No correlation between salinity and stock recruitment 	<p>Negligible</p> <ul style="list-style-type: none"> Freshwater discharges from outfalls and non-point sources may lower salinities but not expected to be substantial 	<p>None</p> <ul style="list-style-type: none"> Pier extension does not include additional freshwater inputs
Dissolved oxygen (DO)	Eggs	<p>Screened out</p> <ul style="list-style-type: none"> Regional DO concentrations are above thresholds of effects No evidence that industrial inputs affect DO concentrations in the study area No correlation between DO and herring recruitment 	<p>Screened out</p>	<p>None</p> <ul style="list-style-type: none"> No evidence of activities or discharges that would lower DO concentrations in the study area 	<p>None</p> <ul style="list-style-type: none"> No evidence of activities or discharges that would lower DO concentrations in the study area
Storms and weather	Eggs and larvae	Presently waiting for time series data			
Lack of vegetation and substrate	Eggs and spawning adults	<p>Screened In</p> <ul style="list-style-type: none"> Poor data about effects of vegetation changes on spawning behavior No information regarding how small-scale changes in vegetation distribution affects concentrated Cherry Point stock 	<p>Negligible to low</p> <ul style="list-style-type: none"> Herring known to spawn on a variety of substrates Spawning habitat not known to be currently limiting at Cherry Point No habitat-loss data to estimate levels of lowest observed effects or type of response by stock 	<p>Negligible to low</p> <ul style="list-style-type: none"> Influences appear to be local around piers, not cumulative over shoreline 	<p>Negligible</p> <ul style="list-style-type: none"> Activities will take place beyond the vegetated zone used by spawners, as long as construction activities are confined to > -12 m (-40 ft) mean lower low water

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, low, moderate, high)
Lack of vegetation and substrate, continued	Larvae and Juveniles	<p>Screened In</p> <ul style="list-style-type: none"> Juveniles in Cherry Point region known to feed on pelagic and epibenthic organisms No data to describe effects of vegetation on energy regime of shoreline that might promote juvenile retention, feeding, and survival before large enough to move offshore Some evidence that juveniles move out of Cherry Point area Juveniles can actively seek out vegetated areas 	<p>Negligible to low</p> <ul style="list-style-type: none"> Little information on juvenile use of nearshore area Some evidence that juveniles move out of Cherry Point area 	<p>Negligible</p> <ul style="list-style-type: none"> Some evidence that juveniles move out of Cherry Point area Juveniles can actively seek out vegetated areas No evidence of long-term trends in vegetation along Cherry Point 	<p>Negligible</p> <ul style="list-style-type: none"> Some evidence that juveniles move out of Cherry Point area Juveniles can actively seek out vegetated areas Impact of overwater structures on predator-prey interactions unknown but likely negligible
Food supply	Larvae	<p>Screened In</p> <ul style="list-style-type: none"> Evidence from other stocks that food supply at first larval feeding is critical to survival No data for Cherry Point 	<p>Negligible</p> <ul style="list-style-type: none"> For larvae, timing of food supply seems more critical than absolute amount Evidence that stock decline due to increased mortality of adults 	<p>Negligible to low</p> <ul style="list-style-type: none"> Potential indirect effects from Fraser River via turbidity or nutrients but no data 	<p>None</p> <ul style="list-style-type: none"> No evidence that pier extension would affect food supply in any way Evidence that stock decline due to increased mortality of adults
Juveniles and adults	Juveniles and adults	<p>Screened In</p> <ul style="list-style-type: none"> Data limited Competition from sardines may be increasing 	<p>Moderate</p> <ul style="list-style-type: none"> Evidence of short-term relationship between euphausiids and herring growth No indication of declining trend, but data limited No data to evaluate the potential for post-spawn mortality 	<p>None</p> <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults 	<p>None</p> <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults No evidence that pier extension would affect food supply in any way

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, negligible to low, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)
Disease	Eggs, larvae, and juveniles	Screened In <ul style="list-style-type: none"> Lack of data 	<p>Low</p> <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults Disease is more likely to be an occasional effect of other stressors 	<p>None</p> <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults No evidence that pier extension influences diseases 	<p>None</p> <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults No evidence that pier extension influences diseases
Adults	Screened In <ul style="list-style-type: none"> Evidence of disease in Cherry Point stock Evidence of mass mortality from disease in other Pacific 	<p>Low</p> <ul style="list-style-type: none"> Condition factor has not declined 	Negligible to low <ul style="list-style-type: none"> Likelihood of increased disease transmission in spawn-on-kelp fishery 	None	None <ul style="list-style-type: none"> Evidence that stock decline due to increased mortality of adults No evidence that pier extension influences diseases
Predation	Eggs	Screened In <ul style="list-style-type: none"> Invertebrate and bird predation can account for substantial loss of eggs 	<p>Low</p> <ul style="list-style-type: none"> No increase in bird abundances observed Evidence that stock decline due to effects on adults 	<p>None</p> <ul style="list-style-type: none"> No data to indicate that human activities have influenced predation on eggs 	<p>None</p> <ul style="list-style-type: none"> Located outside of spawning zone
Larvae	Screened In <ul style="list-style-type: none"> Invertebrate and fish predators prey on larvae, but no quantitative data indicating potential impact 	<p>Low</p> <ul style="list-style-type: none"> No information on trends in larvae predation Evidence that stock decline due to increased mortality of adults 	<p>None</p> <ul style="list-style-type: none"> No data to indicate that human activities have influenced predation on larvae 	<p>None</p> <ul style="list-style-type: none"> Located outside of spawning zone 	
Juveniles	Screened In <ul style="list-style-type: none"> Lack of data 	<p>Moderate</p> <ul style="list-style-type: none"> No information on trends in juvenile predation Evidence that stock decline due to increased mortality of adults Good data on increases in predator abundances Recruitment possibly declining from 1994-1998 	Negligible to low <ul style="list-style-type: none"> Fishery enhancement practices in the Puget Sound area probably increased populations of some fish predators 	Negligible <ul style="list-style-type: none"> Potential cover for some predators Evidence that juveniles leave the Cherry Point area 	

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF		POTENTIAL CONTRIBUTION OF	
			STRESSOR TO DECLINE OF STOCK (negligible, negligible to low, low, moderate, high)	HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)	
Predation, continued	Adults	Screened In • Fish (hake) and marine mammal predation on adults, especially older, larger individuals, may have substantial impact	High • Predation on adults would explain the loss of older age classes and correlations with sea surface temperature • Good data on increases in predator abundances	Moderate • Correlations with sea surface temperature indicate that natural factors most responsible, but Marine Mammal Protection Act and decreased harvest of predatory fish probably play a role	Negligible • Potential cover for some predators	
	Eggs, juveniles, and adults	Screened In • Fishing clearly affects the stock via adult mortality and egg removal	Low • Fishing has declined over time so is not driving the decline, but must have some incremental effect	Low to moderate • Fishing has declined over time so is not driving the decline, but must have some incremental effect	None • Fishing or activities associated with commercial harvest would not occur on the pier extension	
Wave sheltering	Eggs, larvae, and spawning adults	Screened In • Insufficient data assessing effects of existing structures on wave sheltering and sedimentation • Insufficient data relating wave sheltering and sedimentation to effects on herring	Negligible to low • Studies from Gateway Pacific Terminal (GPT) indicate low potential for wave sheltering and sedimentation from pier structures; similarities between GPT and existing structures indicate existing structures would have similar effects; it should be emphasized that these models are from a submitted proposal for a pier and that the design and proposed use of the pier are not approved by WDNR; the risks associated with a design specific to the Pacific International Terminal proposal are not considered in this risk assessment	Negligible to low • Wave sheltering and sedimentation effects not expected to be substantial, and effects on herring expected to be low	Negligible • Proposed pier expected to have similar or lower effect on wave sheltering and sedimentation	

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)
Light shading	Eggs	<p>Screened In</p> <ul style="list-style-type: none"> No data to make determinations regarding direct effects Light shading by piers may reduce exposure of eggs to predation and desiccation Not known whether spawning adults avoid shaded areas Lack of vegetation in shaded areas may affect survival of eggs 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers Shading by boats not over vegetated zone 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers and not likely to be cumulative along shoreline Shading by boats not over vegetated zone 	<p>None</p> <ul style="list-style-type: none"> Activities will take place beyond the vegetated zone
Larvae and juveniles		<p>Screened In</p> <ul style="list-style-type: none"> No data to indicate direct effects, but data about predator use of shaded areas or areas without vegetation not conclusive (see upcoming report from Washington Department of Transportation) 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers and not likely to be cumulative along shoreline Shading by boats not over vegetated zone 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers and not likely to be cumulative along shoreline Shading by boats not over vegetated zone 	<p>Negligible</p> <ul style="list-style-type: none"> No data, but no evidence of increased use of shaded areas by predators
Spawning adults		<p>Screened In</p> <ul style="list-style-type: none"> No data to indicate effects on spawning adults, but data about use of shaded or unvegetated areas for spawning not conclusive 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers and not likely to be cumulative along shoreline Shading by boats not over vegetated zone Not certain whether local effects of lost vegetation could be magnified for remnant stock 	<p>Negligible</p> <ul style="list-style-type: none"> Effects are limited to immediate area around piers and not likely to be cumulative along shoreline Shading by boats not over vegetated zone 	<p>None</p> <ul style="list-style-type: none"> Activities will take place beyond the vegetated zone

Table ES-1, continued

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Vessel traffic	Larvae	Screened In <ul style="list-style-type: none"> Vessel traffic and associated noise will increase over time Larvae with body length >22-36 mm react to acoustic stimuli Lack of data on effects Planktonic larvae may not be able to avoid noise 	Negligible <ul style="list-style-type: none"> Noise from single ship is low because of slow speeds Tug activity may generate more response because of pulsed activity and abrupt changes in speed/rpm Evidence that stock decline due to effects on adults 	Negligible <ul style="list-style-type: none"> Noise from single ship is low because of slow speeds Tug activity may generate more response because of pulsed activity and abrupt changes in speed/rpm 	Negligible <ul style="list-style-type: none"> Because of a lack of information, analysis does not distinguish between the projected increase in operations and increases due to the pier extension alone Pier intended to increase efficiency while the number of ships docking increases 18-36% (comparison to highest historical value and 17-year average, respectively) during spawning months for next 5 years
	Spawning adults	Screened In <ul style="list-style-type: none"> Fish will avoid vessels Evidence that herring are sensitive to noise Potential decreased sensitivity to predators and prey Potential disruption of feeding and migration pathway 	Negligible to low <ul style="list-style-type: none"> Vessel path crosses southeastern border of pre-spawning holding area Increase in ship traffic over time Tug activity may generate more response because of pulsed activity and abrupt changes in speed/rpm Herring can swim to avoid ships 	Low <ul style="list-style-type: none"> Pathway and frequency of ships determined by human activities Vessel construction and engine layout impacts noise levels Changes in rpm and pitch more effective at generating fish response; dependent on captain's boating habits 	Negligible to low <ul style="list-style-type: none"> Because of a lack of information, analysis does not distinguish between the projected increase in operations and increases due to the pier extension alone Pier intended to increase efficiency while the number of ships docking increases 18-36% (comparison to highest historical value and 17-year average, respectively) during spawning months for next 5 years

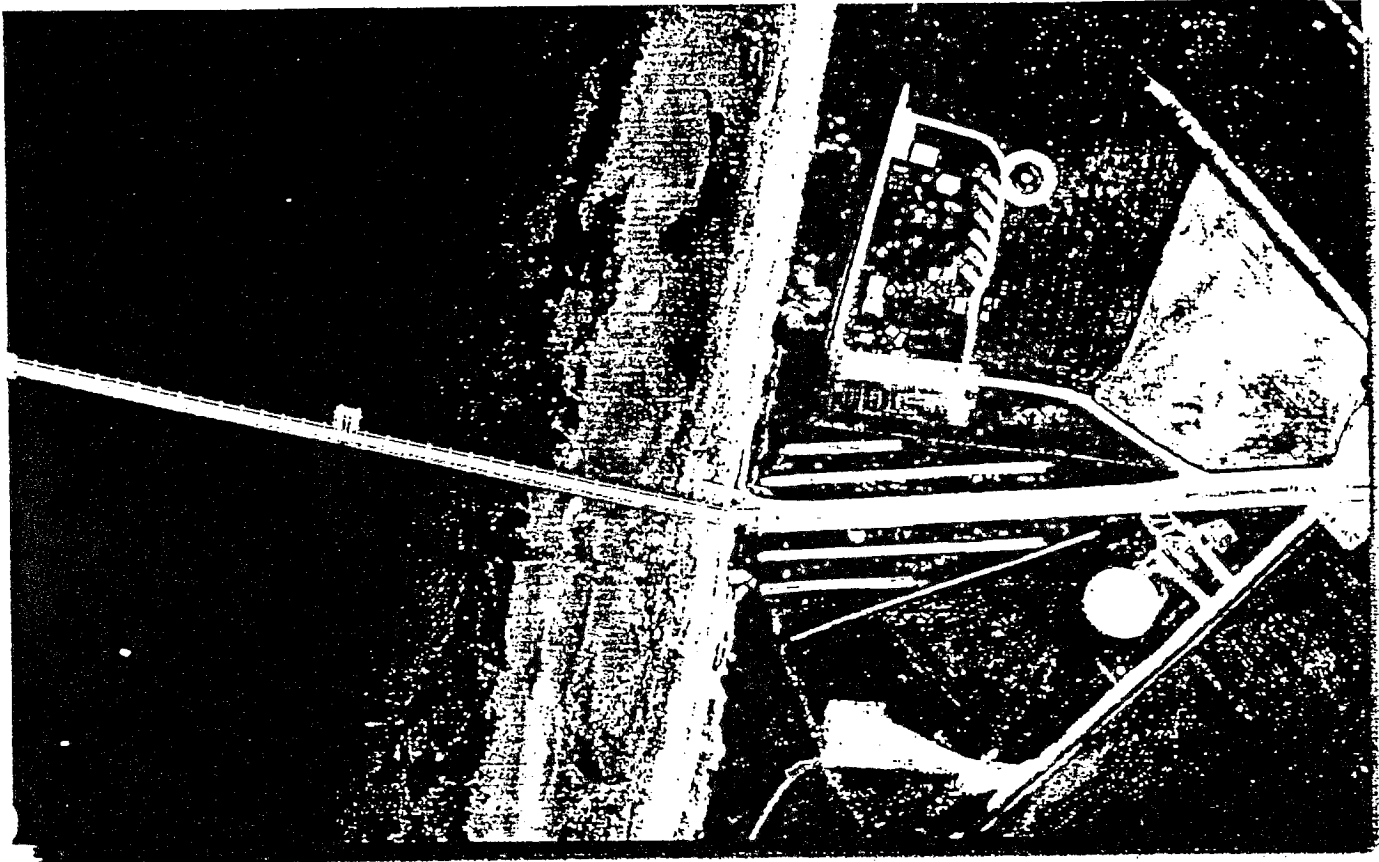
Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF STRESSOR TO DECLINE OF STOCK (negligible, negligible to low, low, moderate, high)	LIKELY CONTRIBUTION OF HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	POTENTIAL CONTRIBUTION OF ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)
Ship disturbance	Eggs, larvae, and spawning adults	Screened In <ul style="list-style-type: none">No data quantifying amount of disturbanceVessels at end of pier outside spawning areaLow levels of propulsion not likely to destroy vegetationResuspended sediment unlikely due to water depth and low propulsion generated; if it occurs, likely to travel along shore and not into spawning area	Negligible <ul style="list-style-type: none">Smothering of eggs or destruction of vegetation unlikelyShip movement is very slow on approach, creating little disturbance	Negligible <ul style="list-style-type: none">Smothering of eggs or destruction of vegetation unlikelyShip movement is very slow on approach, creating little disturbance	Negligible <ul style="list-style-type: none">Activities at pier and any associated disturbance expected to increase
Ship Ballast	Larvae	Screened In <ul style="list-style-type: none">Potential uptake of larvae in ballast water	Negligible to low <ul style="list-style-type: none">Magnitude of larvae mortality unknown	Negligible <ul style="list-style-type: none">Magnitude of larvae mortality unknown	Negligible to low <ul style="list-style-type: none">Because of a lack of information, analysis does not distinguish between the projected increase in operations and increases due to the pier extension aloneNumber of ships docking at ARCO projected to increase 18-36% (comparison to highest historical value and 17-year average, respectively) during spawning months for next 5 years; ballast activities may also increase
Upland noise	Larvae and spawning adults	Screened out <ul style="list-style-type: none">Industrial operations range from 40-85 dBAFacility located away from water	Screened out	None	None <ul style="list-style-type: none">Proposed pier extension would not affect upland industrial processesConstruction activities expected to increase noise temporarily

Table ES-1, continued

STRESSOR	LIFE STAGE POTENTIALLY AFFECTED	SCREENING RESULT AND JUSTIFICATION	LIKELY CONTRIBUTION OF		POTENTIAL CONTRIBUTION OF	
			STRESSOR TO DECLINE OF STOCK (negligible, negligible to low, low, moderate, high)	HUMAN ACTIVITIES TO DECLINE OF STOCK VIA STRESSOR (none, negligible, low, moderate, high)	ARCO PIER EXTENSION TO DECLINE OF STOCK VIA STRESSOR (none, negligible, negligible to low, low, moderate, high)	
Inorganic contaminants	Eggs, larvae, and spawning adults	Screened out • Concentrations of metals in effluent, receiving water, and sediment are within regulatory limits and would not elicit effects to herring	Screened out	None	None	• Possible short term effects during construction only
Organic contaminants	Eggs, larvae, and spawning adults	Screened In • Lack of data for concentrations in receiving waters • Localized sediment contamination in vicinity of ARCO and Intalco • Laboratory and field studies indicate high sensitivity of herring to petroleum hydrocarbons • Embryo toxicity observed in <i>in situ</i> exposures, particularly near localized PAH contamination and sediment toxicity (may be coincidental)	Moderate • Depends on whether embryo toxicity is legitimate toxicity or only natural variation; also depends on site-specific exposure and effects of petroleum hydrocarbons (currently insufficient data) • Mercury screened in as moderate due to organic complexes and biomagnification	Moderate • Depends on whether embryo toxicity is legitimate toxicity or only natural variation; also depends on site-specific exposure and effects of petroleum hydrocarbons (currently insufficient data) • Mercury screened in as moderate due to organic complexes and biomagnification	Negligible • Increased ship traffic facilitated by extension could increase probability of petroleum hydrocarbon spills • Contaminants could be released during construction	
Suspended solids or turbidity	Eggs and larvae	Screened In • Lack of data on trends in nearshore environment • Evidence that turbidity helps improve feeding efficiency for larvae • Wave shading could decrease turbidity and result in higher predation rates	Negligible • Little reason to suspect trends in turbidity over time • Eggs and larvae tolerant of high levels of total suspended solids • Evidence that stock decline due to increased mortality of adults	Negligible • Potential for wave shading effects via decreased turbidity • Ships too far offshore and moving too slowly	Negligible • Potential increase in wave shading may decrease turbidity	

Biological Evaluation



ARCO Products Company Cherry Point Refinery Marine Terminal Pier Addition

Submitted to
The ARCO Cherry Point Refinery
Blaine, Washington

Submitted by
BERGER/ABAM
ENGINEERS INC.

BIOLOGICAL EVALUATION

**ARCO Products Company
Cherry Point Refinery
Marine Terminal Pier Addition**

Prepared for

**The ARCO Cherry Point Refinery
Blaine, Washington**

31 March 2000

Submitted by

**BERGER/ABAM Engineers Inc.
33301 Ninth Avenue South, Suite 300
Federal Way, Washington 98003-6395**

Job No. A00056

**ARCO PRODUCTS COMPANY CHERRY POINT REFINERY
MARINE TERMINAL PIER ADDITION
BIOLOGICAL EVALUATION**

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**ARCO PRODUCTS COMPANY CHERRY POINT REFINERY
MARINE TERMINAL PIER ADDITION
BIOLOGICAL EVALUATION**

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EXECUTIVE SUMMARY

The ARCO Products Company submitted permit applications in 1992 to construct an addition to the existing Cherry Point Refinery Marine Terminal in the SE Strait of Georgia. After extensive studies and negotiations with state and federal agencies and local Native American tribes, ARCO was granted all necessary permits for the project. ARCO has started preparations to begin in-water construction in June 2000.

Because of concerns about federally listed species, ARCO with the assistance of BERGER/ABAM Engineers Inc., has prepared this Biological Evaluation (BE) in compliance with Section 7(c) of the Endangered Species Act. In March 2000, as the designated representative for the ARCO Cherry Point Refinery, BERGER/ABAM requested species lists from U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) of federally protected species within the project area. BERGER/ABAM received a verbal response from NMFS confirming information obtained from the NMFS internet site.

The following list of listed and candidate species for inclusion in this BE was compiled from the NMFS (with verbal confirmation), USFWS, and WDFW internet sites.

- Chinook salmon (*Onchorhynchus tshawytscha*) – Threatened
- Bull trout (*Salvelinus confluentus*) – Threatened
- Coho salmon (*Onchorhynchus kisutch*) – Candidate
- Humpback whale (*Megaptera novaeangliae*) – Endangered
- Leatherback sea turtle (*Dermochelys coriacea*) – Endangered
- Steller sea lion (*Eumetopias jubatus*) – Threatened
- Bald eagle (*Haliaeetus leucocephalus*) – Threatened
- Marbled murrelet (*Brachyramphus marmoratus*) – Threatened

The BE describes baseline environmental conditions in the project area and presents information on the habitat requirements of the listed and candidate species and their potential uses of the project area. Critical habitat for salmonids in the form of existing eelgrass beds (*Zostera marina*) is present in the project action area but will be avoided by the project. In addition, Pacific herring (*Clupea pallasii*), an important prey species for salmon and an ecological keystone species, spawns in the project area. Because of its importance, a screening level ecological risk assessment was conducted on the potential impacts to Pacific herring of the ARCO Marine Terminal pier addition (EVS 1999). The results of the risk assessment, this BE, and a number of other studies show that adverse effects on Pacific herring will be avoided by project design and scheduling. The potential impacts to listed, candidate, and other important ecological species are described in detail in this BE.

The following *recommended* determinations for the effects on listed and candidate species are made in this BE.

- Chinook salmon – Threatened – May affect, but is not likely to adversely affect
- Coho salmon – Candidate – No jeopardy and if listed may affect, but is not likely to adversely affect
- Bull trout – Threatened – May affect, but is not likely to adversely affect
- Steller sea lion – Threatened – No effect
- Humpback whale – Endangered – No effect
- Leatherback sea turtle – Endangered – No effect
- Bald eagle – Threatened – No effect
- Marbled murrelet – Threatened – No effect

INTRODUCTION

The ARCO Products Company Cherry Point Refinery was constructed in 1971 to process Alaska North Slope crude oil delivered by tankers to the refinery pier located on the north side of Cherry Point (Figures 1 and 2). The pier was originally designed in 1969 to permit two tankers to moor and unload simultaneously (Figure 3) (ENSR 1992). This design was submitted to and approved by the U.S. Army Corps of Engineers (Corps) in 1969. However, only the south half of this mooring configuration was constructed in 1971. For economic reasons, ARCO decided to postpone construction of the north mooring berth.

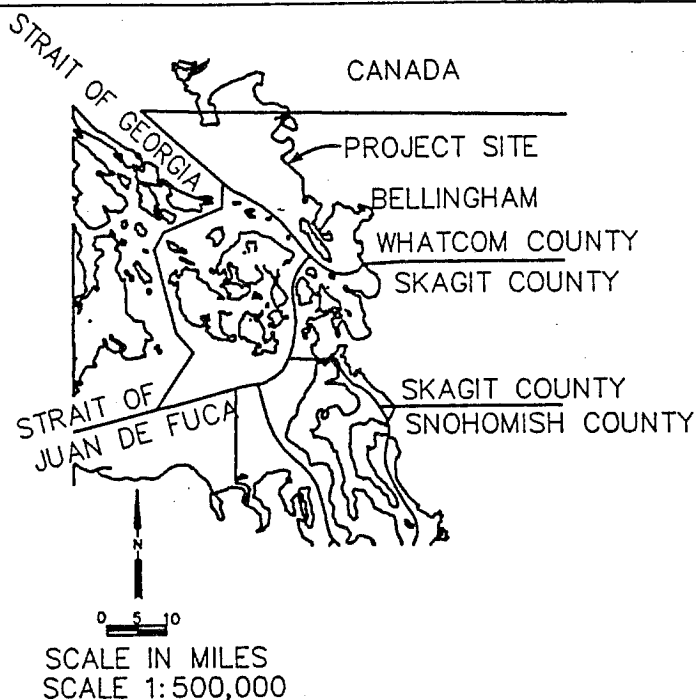
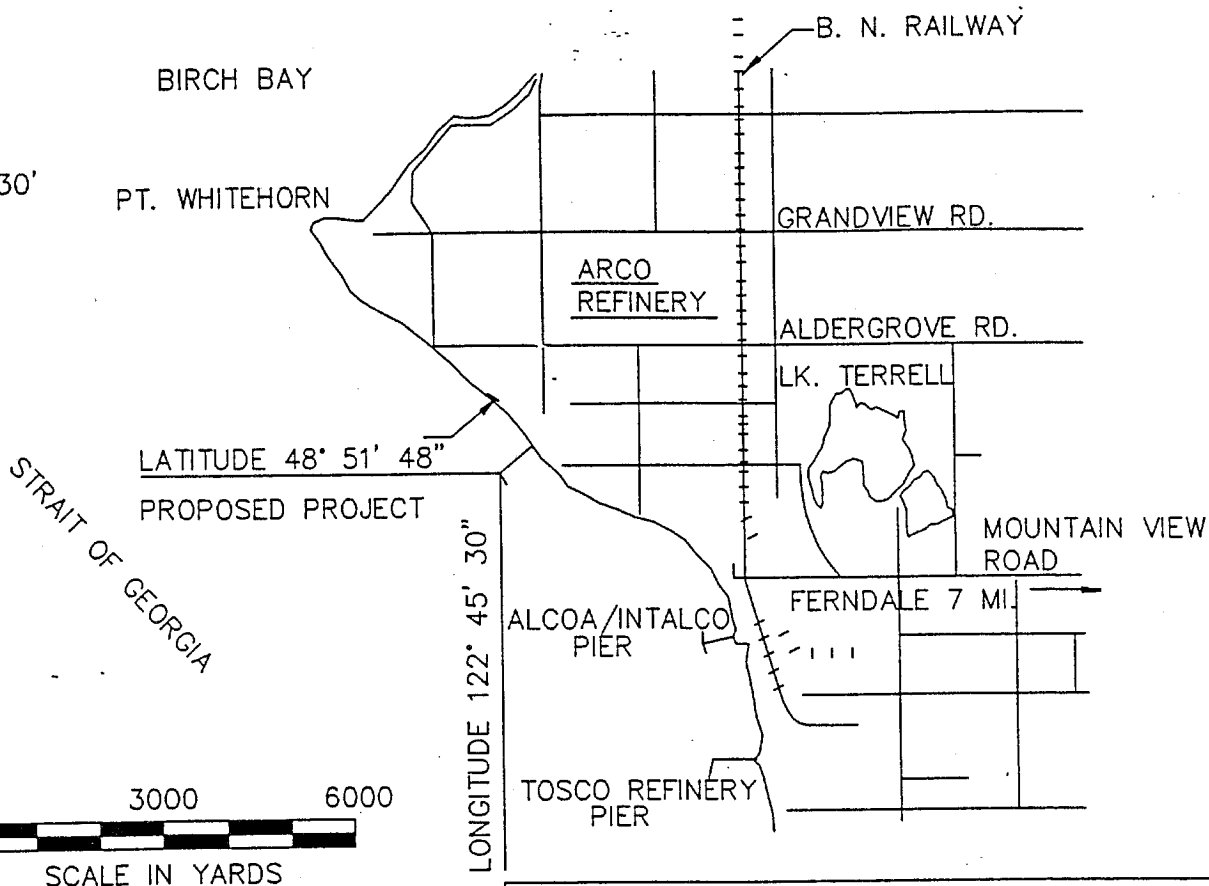
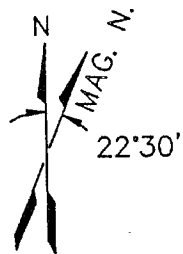
In 1989, ARCO evaluated market forecasts and the projected use of the ARCO Marine Terminal. As a result of this evaluation, ARCO resubmitted permit applications to construct the north trestle and platform on the existing pier. After extensive studies and negotiations with state and federal agencies and local Native American tribes, ARCO was granted all necessary permits for the project. A Corps permit was granted in March 1996. Project work was temporarily halted in 1998 due to lease negotiations with the Washington Department of Natural Resources (WDNR), which have since been concluded. ARCO has begun prefabrication of components in preparation to begin in-water construction in June 2000.

Since the federal listing of chinook salmon (*Onchorhynchus tshawytscha*) as threatened under the Endangered Species Act (ESA), the Corps has required Biological Assessments or Biological Evaluations (BEs) to be written for most waterfront construction projects. Compliance with federal regulations, including the ESA, is required because most waterfront projects apply for and are required to receive a permit for construction in the marine environment by the Corps.

In addition to treating the effects on listed species, organisms identified as "candidates" are included in BEs. Candidate species are those that are currently under review for listing but have no legal protection under the ESA. Candidate species that may occur in the project area, however, are included in this BE because their status could be updated before the project is completed. If a candidate species is subsequently proposed for listing, the early evaluation provided here could result in fewer restrictions on activities by promoting conservation measures that minimize impacts to the species. Furthermore, it may be possible to avert listing in the future by providing protection to candidate species now. This BE, which will be used in consultation by the Corps with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), has been prepared following NMFS (1999) and Corps (Gossett 2000) guidelines and describes the following.

- The project and the specific area that may be affected by the action.
- Listed and candidate species within the project area, their level of use of the area, and any designated or proposed critical habitats within the project area.
- The potential impacts of construction, which may result in disturbance to a listed species and/or their avoidance of the project area.
- Opportunities for the proponent to contribute to the conservation of endangered and threatened species pursuant to Section 7(a)(1) of the Endangered Species Act.

ARCO has voluntarily prepared this BE as a result of discussions with the Corps in parallel with preparation to begin in-water construction in June 2000. The Corps is concerned about potential effects of the planned and permitted pier addition on federally listed threatened and endangered species that may use the project vicinity (Gossett 2000).



NOTE:

1: REFERENCE: U.S.C. & G.S. CHART OF STRAIT OF JUAN DE FUCA AND STRAIT OF GEORGIA
NO: 6380; DATE: 6/10/72.

VICINITY MAP

**ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY**

**BERGER/ABAM
ENGINEERS INC.**

33301 9TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON 98003-6395
(206)431-2300 FAX: (206)431-2250

PURPOSE: PETROLEUM PRODUCT LOADING/UNLOADING FACILITY. NO FEDERAL HARBOR LINES IN EFFECT.
DATUM: MEAN LOWER LOW WATER (MLLW)=0.00 N.O.S.
SOUNDING ARE IN FEET.

PROPOSED PIER ADDITION, PILING, CONNECTING TRESTLE, AND DOLPHIN COMPLETION

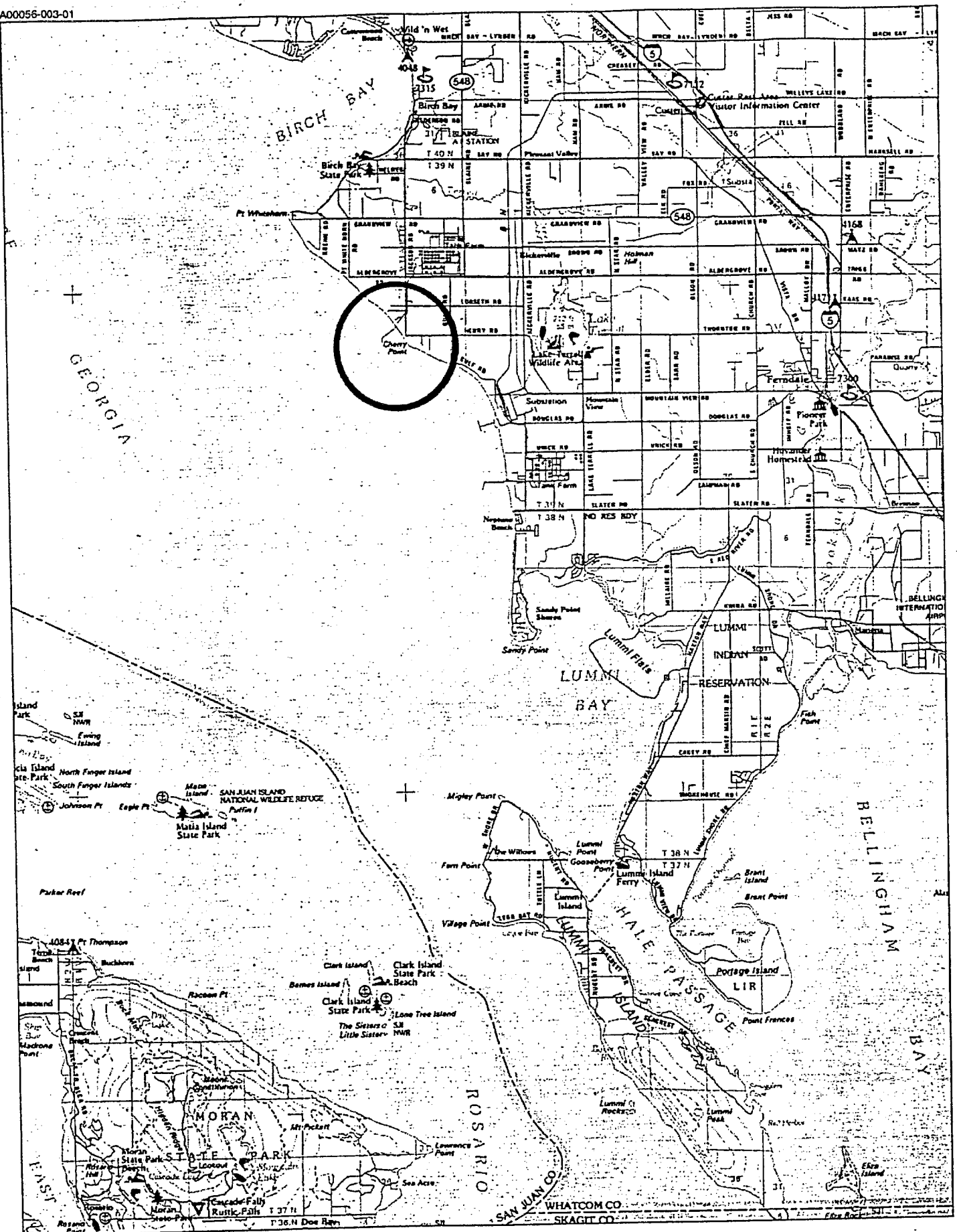
IN: STRAIT OF GEORGIA

NEAR: FERNDALE

COUNTY OF: WHATCOM; STATE: WA

APPLICATION BY: ARCO PRODUCTS CO.,
CHERRY POINT REFINERY

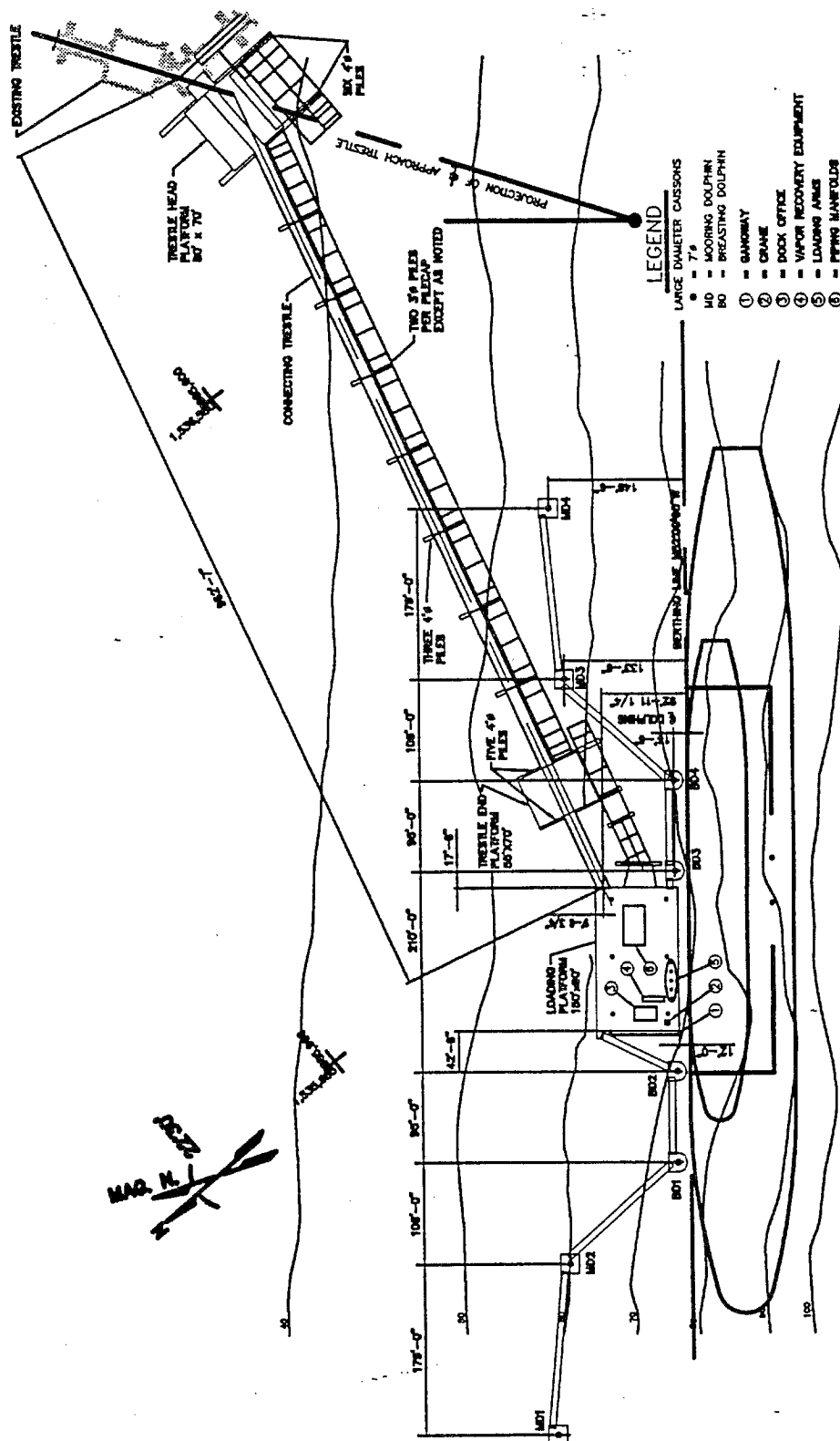
DATE: 3/15/00 FIGURE NO: 1 OF 8



ARCO Cherry Point Refinery Pier Addition
Vicinity Map — Southeast Strait of Georgia

Figure 2

Biological Evaluation ARCO Cherry Point Refinery
Marine Terminal Pier Expansion



PLAN VIEW

ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

BERGER/ABAM
ENGINEERS INC.

33301 9TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON 98003-6395
(206)431-2300 FAX: (206)431-2250

PROPOSED PIER ADDITION, PILING, CONNECTING
TRESTLE, AND DOLPHIN COMPLETION

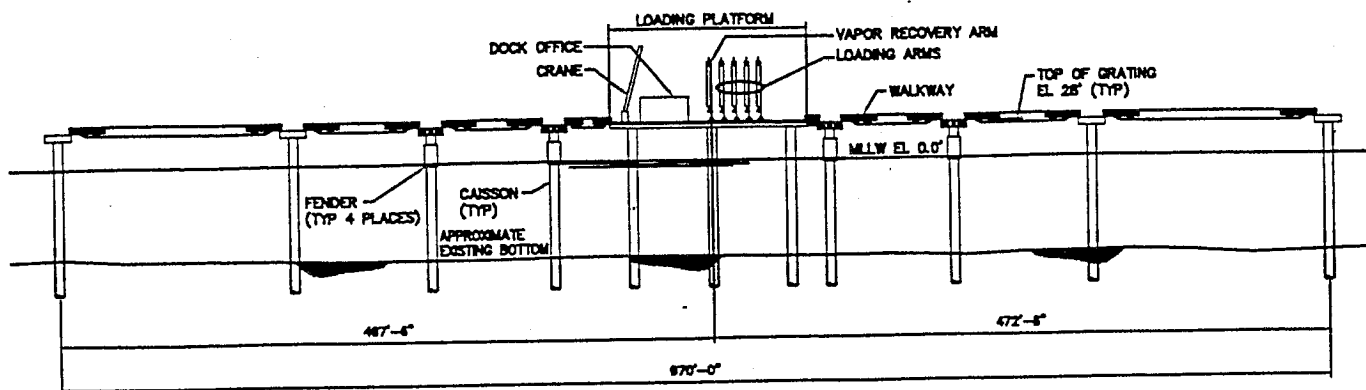
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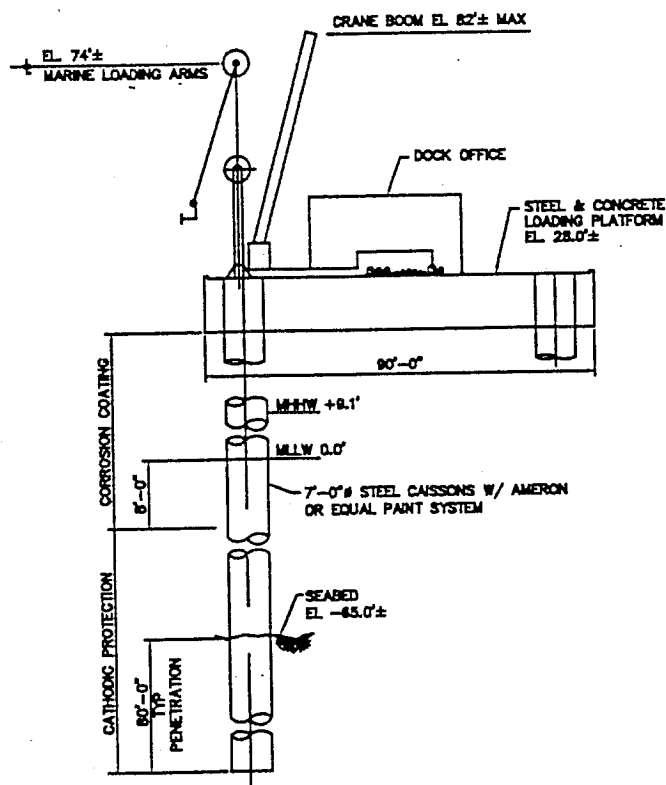
COUNTY OF: WHATCOM; STATE: WA

APPLICATION BY: ARCO PRODUCTS CO.,
CHERRY POINT REFINERY

DATE: 3/15/00 FIGURE NO: 4 OF 8



ELEVATION AT BREASTING LINE



LOADING PLATFORM SECTION



ELEVATION/SECTION
ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

BERGER/ABAM
ENGINEERS INC.

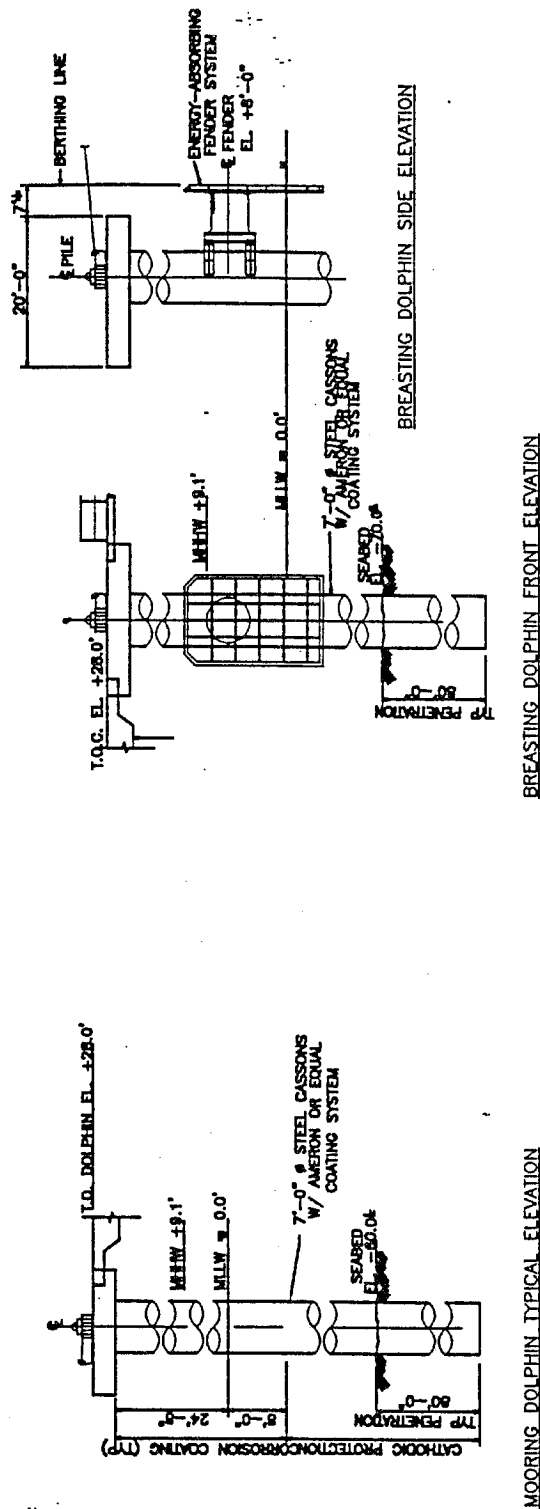
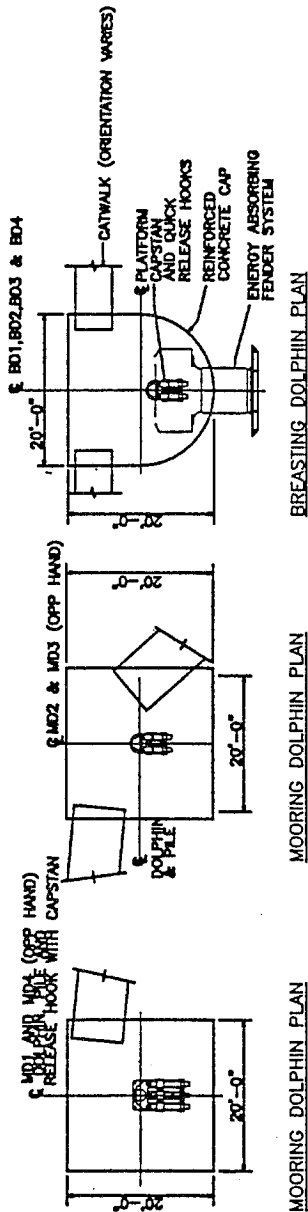
33301 9TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON 98003-6395
(206) 431-2300 FAX: (206) 431-2250

PROPOSED PIER ADDITION, PILING, CONNECTING
TRESTLE, AND DOLPHIN COMPLETION

IN: STRAIT OF GEORGIA
NEAR: FERNDAL

COUNTY OF: WHATCOM; STATE: WA
APPLICATION BY: ARCO PRODUCTS CO.,
CHERRY POINT REFINERY

DATE: 3/15/00 FIGURE NO: 5 OF 8



NOTE:
GENERAL:
1: ALL ELEVATIONS REFER TO MLLW ELEV. 0.0

PLAN/SECTIONS - DOLPHINS
ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

BERGER/ABAM
ENGINEERS INC.
33301 9TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON 98003-6395
(206)431-2300 FAX: (206)431-2250

PROPOSED PIER ADDITION, PILING, CONNECTING
TRESTLE, AND DOLPHIN COMPLETION

IN: STRAIT OF GEORGIA

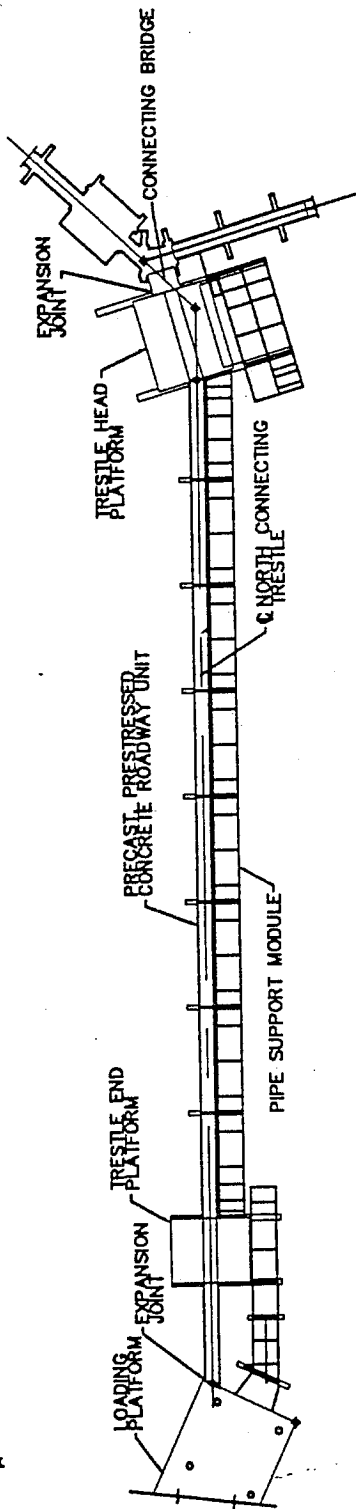
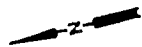
NEAR: FERNDAL

COUNTY OF: WHATCOM; STATE: WA

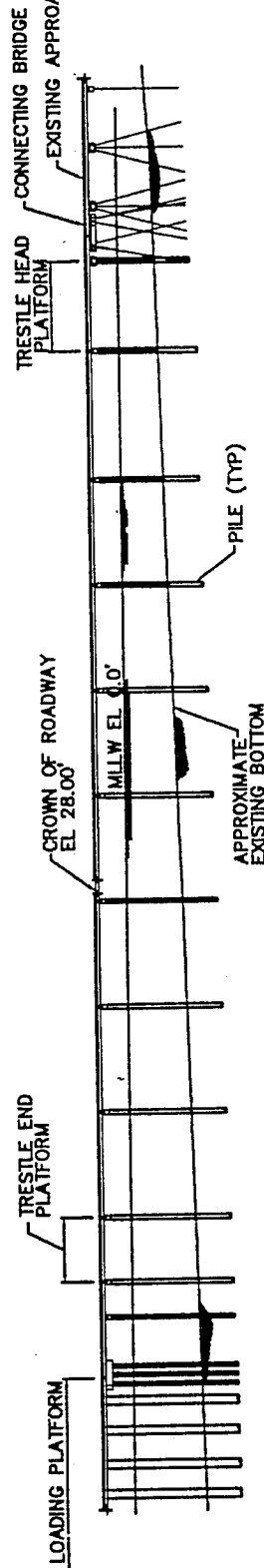
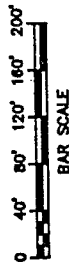
APPLICATION BY: ARCO PRODUCTS CO.,
CHERRY POINT REFINERY

DATE: 3/15/00

FIGURE NO: 6 OF 8



PLAN



ELEVATION

PLAN/ELEVATION-TRESTLE
ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

BERGER/ABAM
ENGINEERS INC.

33301 9TH AVENUE SOUTH
FEDERAL WAY, WASHINGTON 98003-6395
(206)431-2300 FAX: (206)431-2250

PROPOSED PIER ADDITION, PILING, CONNECTING
TRESTLE, AND DOLPHIN COMPLETION

IN: STRAIT OF GEORGIA
NEAR: FERNDAL

COUNTY OF: WHATCOM; STATE: WA
APPLICATION BY: ARCO PRODUCTS CO.,
CHERRY POINT REFINERY

DATE: 3/15/00 FIGURE NO: 7 OF 8



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

Regulatory Branch

Arco Products Company
Box 8100
Blaine WA 98231

Reference: 1992-1-00435
Arco Products Company

Dear Sir:

In accordance with the request submitted by ARCO Products Company dated March 31, 2000, the authorization referenced above granted by the Secretary of the Army on February 26, 1967, is hereby modified.

The permit expiration date is changed from 1 March 2001 to 1 March 2002.

The project must be built in accordance with the attached plans.

The following new Special Conditions apply to the permit:


Special Condition 1. The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the U.S. Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

Special Condition 2. I have completed the necessary coordination under Section 7 of the Endangered Species Act (ESA). You must implement the ESA requirements and/or agreements set forth in the *Biological Evaluation, ARCO Products Company Cherry Point Refinery Marine Terminal Addition*, dated 31 March 2000, and the Addenda to the Biological Evaluation dated 6 April 2000 and 1 May 2000. The U.S. Fish and Wildlife Service concurred with a finding of "may affect, not likely to adversely affect" based on these documents on 13 June 2000. The National Marine Fisheries Service concurred with a finding of "may affect, not likely to adversely affect" based on these documents on 19 June 2000. Both agencies will

be informed of this permit modification and will enforce any known violations of the commitments in this document pursuant to the ESA.

The terms and conditions contained in the original permit remain in full force and effect.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:


James M. Rigsby
Colonel, Corps of Engineers
District Engineer

J



United States Department of the Interior

FISH AND WILDLIFE SERVICE

North Pacific Coast Ecoregion

Western Washington Office

510 Desmond Drive SE, Suite 102

Lacey, Washington 98503

Phone: (360) 753-9440 Fax: (360) 753-9008

JUN 13 2000

Colonel James M. Rigsby, District Engineer
Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, Washington 98124-2255
Attention: Gail Terzi

USACE
REGULATORY BRANCH

RECEIVED
15 JUN 2000

FWS Reference: 1-3-00-I-1362, Bainbridge Ferry Terminal (Kennedy)(2000-1-00176)
1-3-00-I-1363, ARCO Pier Construction (Gossett) (1992-1-00435)
1-3-00-I-1364, Cape George Colony Club (Gossett) (1999-2-00515)

Dear Colonel Rigsby:

This letter responds to your request for informal consultation on the above proposed projects in Western Washington. Your cover letter and supporting documentation were dated May 25, 2000, and received in this office on May 30, 2000. The proposed projects and Biological Evaluations (BEs) were initially presented to us at our batch consultation meetings on April 12, 2000, April 26, 2000, and May 10, 2000. Additional projects mentioned in your request for informal consultation will be addressed in future correspondence.

In your letter you requested that we concur with your determination of "not likely to adversely affect" for the Coastal-Puget Sound distinct population segment of bull trout and the bald eagle as evaluated in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 et seq.).

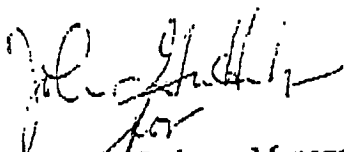
We believe that sufficient information was provided to determine the effects of the proposed projects to federally listed species and to conclude whether these projects are likely to adversely affect those species. We, therefore, concur with the "may affect, not likely to adversely affect" determination for the bull trout. Our concurrence is based on the information described in your letter and supporting documents.

This concludes informal consultation pursuant to the regulations implementing the Act, 50 CFR section 402.13. This project should be re-analyzed if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; if the action is subsequently modified in a manner that causes an effect to the

listed species or critical habitat that was not considered in this consultation; and/or if a new species is listed or critical habitat is designated that may be affected by this project.

If you have further questions about this letter or your responsibilities under the Act, please contact Lou Ellyn Jones (360) 753-5822 or Jim Michaels at (360) 753-7767, of this office.

Sincerely,



Gerry A. Jackson, Manager
Western Washington Office

cc: NMFS, Lacey (Landino)
WDFW, Region 4
WNHP, Olympia



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7000 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

June 19, 2000

FILE COPY

Colonel James M. Rigsby
Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, Washington 98124-2255

Re: WSB-00-0235, Cape George Colony Club (1999-2-00515)
WSB-00-0280, Fred Pratt (1999-2-01791)
WSB-00-0196, Washington State Department of Transportation (2000-1-00055)
WSB-00-0210, Arco Products, Inc. (1992-1-00435)
WSB-00-0112, Port of Everett (1999-1-01618)
WSB-00-0232, Washington Department of Fish and Wildlife (2000-4-00299)
WSB-99-0463, Vancouver-Clark Parks and Recreation (1998-4-02075)

Dear Colonel Rigsby:

This letter responds to your request for informal consultation on the above referenced projects in Western Washington. Your enclosed Biological Evaluations (BE) and other supporting documents were distributed to the National Marine Fisheries Service (NMFS) at batch consultation meetings in 1999 and 2000. We concur with your determination of "may affect, not likely to adversely affect" for:

WSB-00-0235	Puget Sound chinook salmon (<i>Oncorhynchus tshawytscha</i>).
WSB-00-0280	Puget Sound chinook salmon
WSB-00-0196	Puget Sound chinook salmon
WSB-00-0210	Puget Sound chinook salmon
WSB-00-0112	Puget Sound chinook salmon
WSB-00-0232	Lower Columbia River chinook salmon
	Lower Columbia River steelhead (<i>Oncorhynchus mykiss</i>)
	Columbia River chum salmon (<i>Oncorhynchus keta</i>)
WSB-99-0463	Lower Columbia River chinook salmon
	Lower Columbia River steelhead
	Lower Columbia River chum salmon

We believe that sufficient information was provided to determine the effects of the proposed projects to federally listed species and to conclude whether these projects are likely to adversely affect those species. Our concurrence is based on the information and conservation measures described in the BEs.

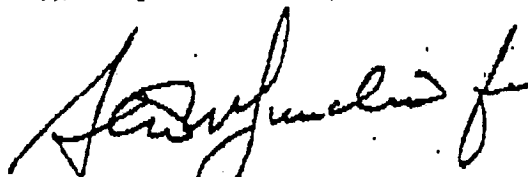


-2-

This concludes informal consultation and conference pursuant to the regulations implementing the Act, 50 CFR Sections 402.10 and 402.13. These projects should be re-analyzed if new information reveals effects of the actions may affect listed species or critical habitat in a manner or to an extent not considered in this consultation and conference; if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation and conference; and/or if a new species is listed or critical habitat is designated that may be affected by these projects.

If you have questions concerning this response, please contact Gordon Zillges of the Washington State Habitat Branch Office at (360) 753-9090.

Sincerely,



William W. Stelle Jr.
Regional Administrator

L

Construction of the ARCO Marine Terminal pier addition will consist of three construction activities.

- Onshore fabrication of large concrete, steel, and pipe modules
- Installation of steel pipe piling and caissons
- Erection of the prefabricated modular units

The types of equipment that will be used on the site will include floating crane derrick barges, material supply barges, support tugboats, work skiffs, and welding and grouting equipment. The vast majority of the materials required for construction will be delivered to the site on the crane or supply barges. A relatively small quantity of cast-in-place concrete and small items may be delivered to the site by truck over the existing ARCO Marine Terminal pier.

Best Management Practices

The Contractor may alter the construction sequence and the equipment used to decrease the overall construction time. However, Best Management Practices (BMPs) will be followed regardless of the sequence of events. BMPs for construction on-site and in-water work are as follows.

- The Contractor will follow all timing restrictions as directed in existing permits to avoid in-water work when juvenile salmonids and spawning Pacific herring (*Clupea pallasii*) are most likely to be present.
- All work will take place seaward of -35 feet mean lower low water (MLLW). Disturbance of existing submerged marine vegetation (SMV) and other nearshore shallow water habitats will be avoided.
- The contractor will be restricted from placing anchors in sensitive areas such as SMV beds and shallower than -20 feet MLLW.
- The construction techniques will maximize use of onshore prefabricated modular units to minimize in- and onwater construction.
- Use of steel mono-pile construction will minimize the impact on the marine environment and biota by decreasing the total number of piles required. A total of fourteen 84-inch caissons, twenty-five 48-inch piles, and sixteen 36-inch piles will be installed. Use of conventional battered piling would necessitate installation of over 150 to 200 piles.
- The steel piles and caissons will be coated during their construction offsite with a protective coating to prevent corrosion. This product, Tideguard®, is a spray-on epoxy cladding, which, unlike the older coal-tar epoxy used in the original construction, will not weather or deposit petroleum hydrocarbons into the marine environment (Quinn 2000). In addition, each piling or caisson will be sealed at the top, which will also prevent corrosion on the interior of the piling or caisson.
- The steel piles and caissons that will be used to support the pier addition will be hollow and will not be filled with concrete or other materials after installation.
- The piles and caissons will be driven as open-ended cylinders into the seafloor. Each caisson or piling will be sealed at the top after driving during installation of the precast pile caps.

- The contractor will use a vibratory hammer to initially place and drive the caissons and piles. This process will eliminate the need for the installation and removal of temporary brace piles to hold the caissons and piles in position. Vibratory hammers operate much quieter than impact type pile hammers; thus, the noise normally associated with pile driving will be greatly reduced.
- Jetting or excavation techniques will not be used to install the piles unless a substantial obstruction is encountered. In this case, jetting or excavation would be conducted only inside the piling or caisson to remove or displace the obstruction.
- The contractor will have a tugboat on site at all times when one or more derrick barges are working for sudden changes in weather or other emergencies.
- Although this project has been designed with prefabricated modular units to the greatest extent feasible, some on-site grouting of connections and closures will be required. The contractor will be required to caulk the forms to ensure that they are watertight and no concrete or grout leaks out during placement. No concrete or grout will be allowed to enter the waters of the State.
- The contractor will have oil-absorbent materials on site for use in the event of a spill or if any oil product is observed in the water.

Year 2000 Construction Activities

Set Moorages and Rig to Drive Piles — Upon arrival on site, floating crane Derrick 24 will first deploy up to four mooring buoys attached to heavy anchors to the south of the existing ARCO pier for storage of material barges and derrick barges when not in use. These mooring buoys will be positioned in a line beginning approximately 1,000 feet to the south of the existing ARCO berthing facility to prevent interference with daily operations. The mooring buoys will be spaced approximately 500 feet apart and placed far enough away from the shore to ensure that the barges attached to the buoys will not shadow SMV beds.

After setting the mooring buoys, Derrick 24 will be moved by tugboat to the north side of the existing dock to deploy its anchors and set up for pile driving. The derrick anchors will be set on the seabed offshore of any SMV beds, below -20 feet MLLW. The derrick will then be able to move on its own anchors into position to begin caisson and pile installation.

Install Caissons and Piles: First Load — Derrick 24 will begin the project by installing seven of the 84-inch-diameter caissons followed by the 48-inch and 36-inch piles. A barge with the caissons or piles to be installed aboard will be brought alongside Derrick 24 by a tugboat. The derrick will lift a caisson or pile from the barge into the vertical position, and the tugboat will return the barge to the mooring buoy for storage. The derrick will set the end of the pile on the seabed along the side of the derrick barge in a positioning horn and secure it to prevent it from falling over. The derrick will be disconnected from the top of the caisson that is now held fast in the vertical position. The derrick will then pick up the "Tandem King Kong" vibratory hammer and set it in place on top of the pile. The hydraulic clamps on the vibratory hammer will be closed, and the caisson will be lifted several feet above the seabed and positioned to the location shown on the drawings. The caisson (attached to the vibratory hammer) will then be set on the seabed, and the position will be rechecked and adjusted as necessary. Once the location has been verified, the vibratory hammer will be turned on and the caisson or pile will be driven into the seafloor a minimum of 25 feet or to refusal. If the caisson or pile does not meet refusal, the vibratory hammer will be used to drive the caisson or pile to the design maximum penetration of 70 feet for the 7-foot-diameter caissons, 56 feet for the 4-foot-diameter piles, and 51 feet for the 3-foot diameter piles.

If a caisson or pile meets refusal or takes longer than 2 hours to reach its design depth, the vibratory hammer will be turned off and the hydraulic clamps opened. The vibratory hammer will be lifted off the caisson or pile and set on the deck of the derrick barge. The "Menck MHU 500T" hydraulic impact hammer will then be lifted by the derrick and set on top of the partially driven caisson or pile. The impact hammer will be turned on and the caisson or pile will be driven to design penetration depth into the seafloor. Upon reaching the design depth, the hammer will be turned off and set on deck and the process repeated with the next caisson or pile.

Installation of each caisson is expected to take about two days to complete. Installation of twelve 48-inch and eight 36-inch-diameter piles will follow installation of the seven caissons. The same methods and equipment will be used to install the smaller piles as the caissons, except adapters will be employed to fit the hammers to the smaller piles. The installation of each pile is expected to take about one day to complete. Installation and removal of the adapters will also take a few days for each size change.

Tow to Tacoma and Return: Second Load Out — Upon completion of the installation of the first load of caissons and piles, Derrick 24 will retrieve its anchors and a tugboat will tow it to Tacoma to load out the remainder of the caissons and piles onto barges. While in Tacoma, Derrick 24 will also load out the precast concrete pile caps to barges to allow placement concurrent with the installation of the second load of caissons and piles. Derrick 24 will then be towed back to the site to deploy its anchors as previously described. The entire trip, from retrieving anchors to re-deploying them, will be completed in two weeks time.

Install Caissons and Piles: Second Load — Following the load out in Tacoma, Derrick 24 will resume pile driving. Installation of the remaining seven 84-inch-diameter caissons will come first, followed by the thirteen 48-inch and eight 36-inch-diameter piles, using the same methods as previously described.

Erect Precast Concrete Pile Caps — As Derrick 24 completes the installation of the last of the 48-inch and 36-inch-diameter piles, a second derrick barge, the *Scandia*, will be mobilized to the site. The *Scandia* will first serve as the support platform for installation of scaffolding on the piles and preparation of the piles to accept the precast concrete pile caps. The *Scandia* will also be used to install the smaller pile caps (Nos. 3 through 13). The deck of the *Scandia* will be used to stage welding and grouting operations. The larger pile caps (Nos. 1 and 2), will be installed by Derrick 24. Placement of these two pile caps will follow installation of the last of the piles and during the refit of the vibratory hammer to drive the remaining 84-inch-diameter caissons. Installation of the pile caps will be completed concurrently with the installation of the second load of piles and caissons. The *Scandia* will be demobilized from the site as soon as the placement of the pile caps is completed. This process is expected to be complete in about 32 workdays.

Tow to Tacoma and Return: Load Out Precast Concrete Decks — When all the caissons and piles are installed, Derrick 24 will again retrieve its anchors and a tugboat will tow it to Tacoma. The derrick will load out 24 precast concrete deck sections on two barges and return to the site to deploy anchors and set up for erection of the precast. This trip will take about one week.

Erect Precast Concrete Roadway Decks — Derrick 24 will erect one to two precast deck sections per day, depending on the size and location in the structure. The deck of the derrick will also serve as a staging area for welding and grouting operations required to secure the deck sections in place once placed. This entire task is expected to take about 18 workdays.

Year 2001 Construction Activities

Set Moorages and Rig Up — Two derrick barges will be required for the year 2001 construction season. The *Scandia* will be used to erect the pipe modules, fenders, walkways and the smaller

mechanical items such as loading arms. Derrick 24 will handle the larger and heavier pieces, the cap frame, loading platform modules, and the dolphin caps. The derricks will be towed to the site and deploy anchors as discussed for the year 2000 construction season.

Load, Transport, and Erect Pipe Modules — Prior to arrival on site, the *Scandia* will load out prefabricated pipe modules to barges in Bellingham. The derrick will be towed to the site and deploy anchors. Each of the pipe modules will be lifted from a barge and set into position by the *Scandia*. The modules will be welded in place, using the previously installed roadway decks for access and staging areas. Due to the size and shape of the individual modules, only a few will fit on a barge at a time. Thus, the *Scandia* and barges will have to return to Bellingham several times to load out, transport, and erect all the pipe modules. This activity is expected to take about 24 workdays to complete.

Load, Transport, and Erect Cap Frame — The cap frame is a major structural component of the loading platform. It will be constructed of 60- and 72-inch-diameter steel pipe. The cap frame will be supported by six of the 84-inch-diameter caissons and will, in turn, support the structural steel and concrete loading platform modules. When completed, the cap frame will be 126 feet long by 90 feet wide, and will weigh about 275 tons. Derrick 24 will load out the cap frame to a barge in Tacoma prior to arrival on site. The derrick will set up on site as previously discussed and lift the cap frame from the barge. The cap frame will then be set directly on top of the six 84-inch caissons. The derrick will also serve as the staging platform for grouting the connections between the cap frame and the caissons. This process is expected to take eight work days to complete, and will be accomplished concurrently with the erection of the pipe modules.

Load, Transport, and Erect Loading Platform — The loading platform consists of six structural steel frames topped with a reinforced concrete deck. The modules range in length from 70 to 75 feet long by 20 to 43 feet wide, and weigh from 163 to 345 tons. Derrick 24 will load the modules on to barges in Bellingham, tow back to the site, and set up. Each of the modules will be lifted from the barge, set in position, and bolted to the cap frame. This activity is expected to take 10 workdays to complete, and will also be accomplished concurrently with the erection of the pipe modules.

Load, Transport, and Erect Dolphin Caps — After completing the erection of the loading platform, Derrick 24 will return to Tacoma to load out the precast concrete dolphin caps. Each of the four caps will be about 20 feet square and weigh about 136 tons each. In addition, four breasting dolphins with caps will be installed. Each cap will be approximately 20 feet square and weigh about 123 tons. Derrick 24 will return to the site and setup. Each dolphin cap will be lifted from the barge and welded in place atop an 84-inch-diameter caisson. This task will be completed in approximately 11 workdays. Derrick 24 will be demobilized from the site upon completion of this task.

Load, Transport, and Erect Fenders and Walkways — The *Scandia* will be towed back to Bellingham after completing the erection of the pipe modules to load out the fenders and walkways. The four fenders will be welded to the 84-inch-diameter breasting dolphin caissons on site. The *Scandia* will lift the fenders from the barge and hold them in position until enough welds are made to support them. The *Scandia* will also erect the eight walkways from the loading platform to each of the dolphin caps. This process is expected to take about 18 workdays.

Load, Transport, and Erect Loading Arms and Mechanical Items — This activity consists of the load out, transport, and erection of the five loading arms, the vapor combuster stack, and the final piping connection sections. The *Scandia* will be towed to Bellingham to load out these items and returned to the site several times. The derrick will be set up in position and erect each piece as required. Erection of these final items will be completed in approximately 12 workdays. Following the completion of this activity, the *Scandia* will also be demobilized from the site. At this point, all barge work is complete.

several studies have included the ARCO project area (e.g., Everitt et al. (1980) on marine mammals, Jeffries et al. (1997) harbor seals, Nysewander (1999) on marine birds and mammals, and Speich (1995) on marbled murrelets).

In addition to the studies on biota, specific studies have been conducted on the quality of marine waters and sediments in the vicinity of the ARCO Marine Terminal. A marine water quality study with special emphasis on metals was conducted in the nearshore waters off Cherry Point in 1998 (Creclius 1998). Studies have been conducted in 1974 (Battelle 1975) and 1989 through 1992 on marine sediments under and around the ARCO Marine Terminal to define the source and extent of chemical contamination (ENSR 1991, 1992b). Additional sediment monitoring is being planned in conjunction with the National Pollution Discharge Elimination (NPDES) permit issued in 1999.

DESCRIPTION OF THE PROJECT AREA

Action Area

The "action area" that is anticipated to receive direct impacts from the construction and operation of the pier addition consists of an area about 0.6 mile in diameter around the location of the construction. This area size is designated because of studies conducted in 1971 (Battelle 1974), 1988 (Ardea Enterprises 1989), and subsequently (Kyte et al. 1999b) that showed that direct effects from operation of the marine terminal would be most likely within this area.

An action area for indirect and cumulative impacts is defined as the shoreline from Birch Point to Sandy Point and nearshore waters out to about 4.5 miles from shore. This is the area defined as the study area for the Cherry Point Annotated Bibliography and Literature Review (Kyte et al. 1999 a and b). It is also the area upon which the SLERA focussed (EVS 1999). WDNR designated this area in ARCO's Aquatic Lands Lease as the primary study area ("Exhibit D" "Study Area 1") for Pacific herring studies. In addition, two recent oil spills from the Tosco Ferndale Refinery marine terminal impacted shorelines within and immediately adjacent to this area (Kyte et al. 1999b, EVS 1999).

Existing Developments

Within the direct impact action area, the only existing development is the ARCO Marine Terminal (Figures 1 and 2). This terminal consists of a causeway, approach trestle, and an unloading platform with the unloading platform lying nearly parallel to the shoreline approximately 2,150 feet offshore (Figure 3). Use of this pier was summarized previously.

The action area for indirect and cumulative impacts includes two additional industrial marine terminals, a state park (Birch Bay State Park), and two recreational marinas. The marinas are in Birch Bay and at Sandy Point. The industrial facilities are the Alcoa Intalco Works Marine Terminal approximately 1.5 miles south of ARCO and the Tosco Ferndale Refinery Marine Terminal about 2.5 miles south towards Sandy Point (Figure 1). The Tosco terminal receives about 600 annual ship trips of both large commercial vessels and barges (EVS 1999). The Alcoa Intalco terminal receives only about 30 annual ship trips, and transships aluminum ore and products and refrigerated propane gas.

In addition to the shoreline developments, marine vessel traffic is extensive in the Strait of Georgia in the indirect and cumulative impact action area. According to the 1999 SLERA (EVS 1999), on average, 15 large commercial vessels transit the area daily. Up to 10 smaller tug and lumber barges also transit this area daily. In addition, numerous recreational vessels and over 100 fishing boats may transit the area daily, depending on the season.

Baseline Conditions

Substrates

The intertidal marine sediments in the intertidal and shallow subtidal zones (above about -10 feet MLLW) along the Cherry Point shoreline are diverse and dynamic in nature (Kyte et al. 1999b). These sediments consist of mixed coarse materials including predominantly sand with gravel, cobbles, and boulders of a wide range of sizes. Little silt and clay is present in these sediments because of wave action.

The intertidal sediments and those of the shallow subtidal zone, above about -10 feet MLLW, are subject to disturbance by wave and tidal current action. The longshore sediment transport direction along the Cherry Point shoreline is from the north (Point Whitehorn) to the south towards Sandy Point. Within Birch Bay, the longshore drift vectors are from Point Whitehorn and Birch Point into the bay with a convergence in the northeast part of the bay.

Below about -10 feet MLLW within the direct action area, the sediments become more uniformly sandy with patches of gravel and occasional boulders. Under and around the ARCO Marine Terminal and at the location of the new pier addition, the sediments are firm silty sand subject to relatively strong tidal currents (about 1 or more knots per hour).

Marine sediments in the vicinity of the ARCO Marine Terminal were evaluated to determine compliance with Washington State SMS as described in a previous section. The ARCO Cherry Point Refinery conducted a baseline monitoring investigation in 1974 (Battelle 1974) shortly after beginning operations in 1971. As a part of this study, tests were made for total hydrocarbons in intertidal and subtidal sediments in the vicinity of the ARCO marine facility, with the result showing that hydrocarbons were below detection limits (0.35 parts per million) at all locations tested.

Following the 1974 study, ARCO conducted another baseline monitoring investigation in 1991 (ENSR 1992). This investigation followed the discovery of elevated levels of polynuclear aromatic hydrocarbons (PAHs) in sediments in the vicinity of the ARCO pier (Ardea Enterprises 1990). The ENSR investigation found that sediments immediately adjacent to and under the ARCO pier were contaminated with PAHs with some compounds exceeding SQS. Sampling at locations removed from the vicinity of the pier found no contamination by organic or inorganic chemicals. Additional testing showed that the source for these compounds was weathering products from the coal-tar epoxy coating on the steel piling supporting the ARCO pier.

Submerged Marine Vegetation (SMV) — Critical Habitat

Eelgrass beds (*Zostera* spp.) are considered to be critical habitat for chinook and other salmonid species because of the close association between outmigrating salmonid juveniles and SMV. Within the direct action area, the SMV is typical of that found along the Cherry Point shoreline (EVS 1999; Kyte 1994c, 1996). Where suitable substrate is present (e.g., rocks for macroalgae attachment), SMV extends from the middle intertidal zone down to about -30 feet MLLW. Eelgrass (*Zostera marina*) is present on both sides of and under the existing pier (Figure 8) and extends to only about -6 feet MLLW in the vicinity of the ARCO pier due to chronic natural turbidity and mobile sediments (Kyte 1996). Thus, the seafloor at the location of the pier addition does not support any SMV, as this area is approximately 35 to 90 feet below MLLW. However, kelp (*Nereocystis luetkeana*) and other macroalgae have been reported attached to the piling supporting the Marine Terminal (Kyte 1996).

In 1992, when the most recent survey of marine algae was conducted at the ARCO Marine Terminal, the dominant plants were *Alaria* sp., *Constantinea simplex*, *Desmarestia* spp., *Sargassum muticum*,

and eelgrass. Except for eelgrass, the average cover of all species was less than or equal to about 6 percent (Kyte 1994c).

Habitats and Characteristic Invertebrate Species

Nearshore habitats and characteristic species within the direct effects action area are typical of those found along the Cherry Point shoreline (EVS 1999). Loose gravel and large boulders characterize the upper intertidal zone with sand becoming more prevalent at lower elevations (Figure 8). These sediments support only amphipods and marine insects due to their elevation and mobile nature.

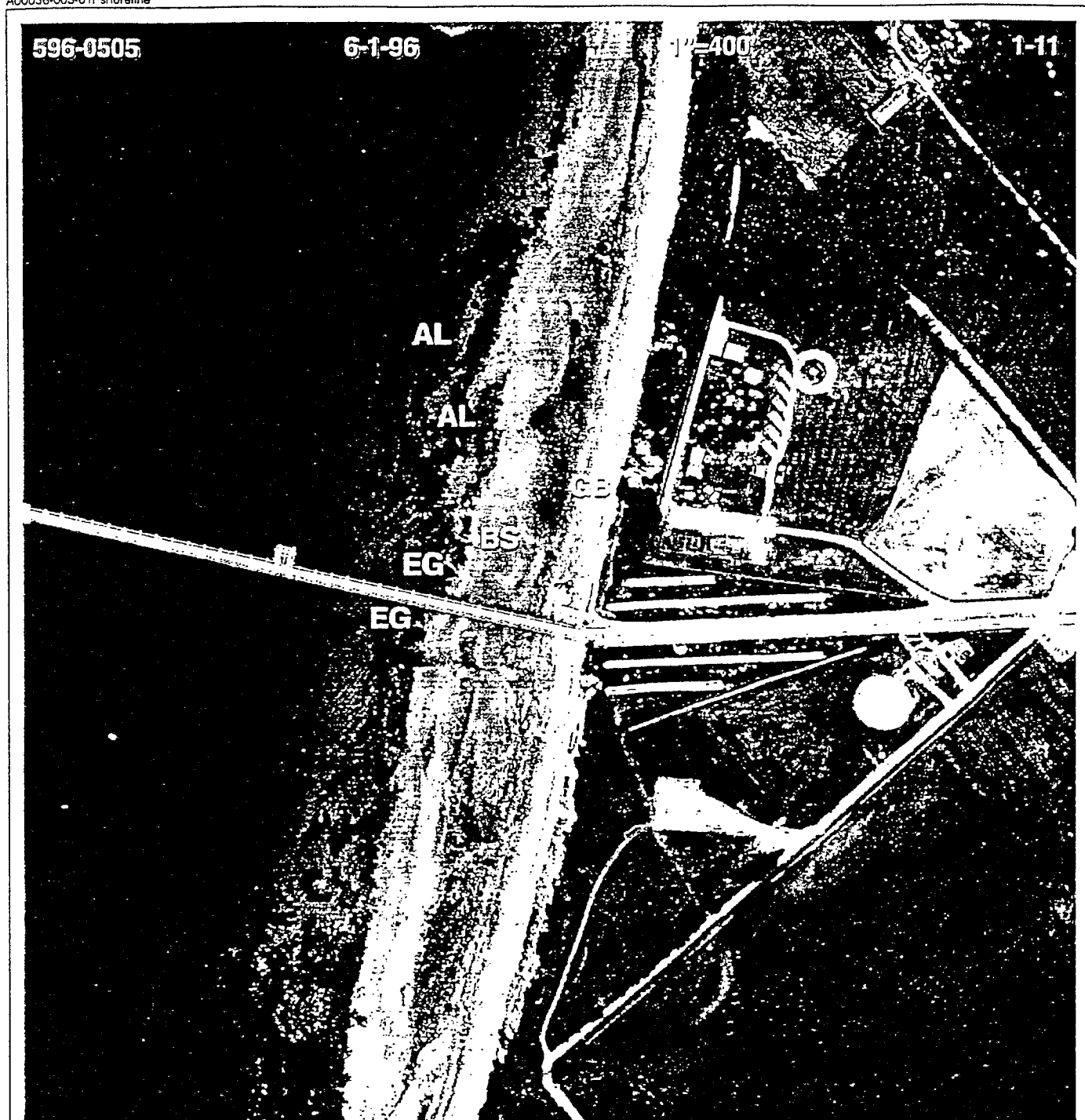
Below about +4 feet MLLW the beach grades into a bench with a relatively flat gradient that extends about 1,000 feet seaward to about -30 feet MLLW where the slope again steepens. The habitats of this relatively flat bench are dominated by dynamic sandy mixed coarse sediments with large patches of sand interspersed with patches of boulders, cobble, and gravel (Figure 8). Much of the sand is mobile inhibiting the growth of eelgrass. Eelgrass has successfully colonized only in depressions surrounded and stabilized by cobbles and boulders. In addition to the eelgrass, characteristic species of the open sandy habitats include crabs, moon snails (*Polinices lewesii*), and seastars.

An important feature of the mixed cobble and boulder patches occurring between the upper intertidal gravel berm and about -20 feet MLLW is the availability of a large number of microhabitats. A cobble boulder bed provides living space for invertebrates not only on the exposed surfaces, but also in the protected crevices between individual rocks and under rocks that are not deeply imbedded. This variety of living space tends to significantly increase species diversity in comparison to other more uniform habitats such as sand and gravel. The characteristic epifauna in the vicinity of the ARCO Marine Terminal include barnacles, snails, chitons, limpets, mussels, and seastars. Under and between the cobbles and boulders are found small shore crabs, polychaete worms, and tide pool shrimp.

At the location of the planned pier addition a silty gravelly sand habitat prevails with relatively strong tidal currents (1 or more knots during maximum ebbs and floods). This habitat is characterized by a sparse epifauna which includes the sea pen (*Ptilosarcus guernei*), nudibranchs, Dungeness crabs (*Cancer magister*), and small crangonid shrimp. The infauna of the silty sand sediments is dominated by the ophiuroid echinoderm *Amphiodia periercta* and geoduck clams (*Panope abrupta*) (Kyte 1994a). Geoduck populations were determined in 1994 at approximately 0.03 geoducks per square foot (Kyte 1994a). Besides this echinoderm and geoduck clams, polychaete worms, bivalves, burrowing anemones, and other echinoderms characteristic of finer sediment habitats are present.

Adult Dungeness crab are common along the Cherry Point shoreline and support recreational and commercial fisheries in the area. The ARCO and other studies show that the crab population at Cherry Point is cyclic and has remained the same in its cycles and distribution over the last several years. The trawl catches of crab at the sampling stations at the ARCO pier were compared with other crab studies from Cherry Point with a strong positive correlation between areas (Kyte 1994a). The low catches in the fall and winter by trawl and trap show a definite offshore movement of crabs at this time and a low use of inshore habitats. The crab move back inshore in the spring and summer as shown again by the trawl and trap data. Four years of accumulated crab trawl catches by Kyte (1994a) in the vicinity of the ARCO Marine Terminal show that the time of highest abundance is in the spring, with April yielding the largest catches.

In addition to the cycles in abundance, the occurrence of female crabs with external eggs ("gravid females") and of soft-shelled crabs showed a definite seasonal trend in Kyte's studies (1994a). Egg-

**Key**

- | | |
|----|--|
| BS | Bare Sand |
| AL | Macroalgae Covering Cobbles and Boulders |
| EG | Eelgrass |
| GB | Gravel Berm |

ARCO Cherry Point Refinery Marine Terminal Pier Addition
Shoreline Characteristics and Habitats

Figure 8

bearing females were found in trawls and traps mostly in the late winter and early spring. Soft-shelled crabs were found mostly in the late spring and summer as expected from studies in other areas. The commercial fishery is closed at this time to protect these easily damaged crabs.

Finfish

The Cherry Point shoreline and the area in the vicinity of the ARCO Marine Terminal support a wide variety finfish, the most notable of which is the Pacific herring. Pacific herring is an ecological keystone species in Pacific Northwest marine ecosystems and is an important food resource for federally listed and other salmonid and marine bird and mammal species. Because of long-term declines of spawning populations in the vicinity of Cherry Point and at other locations in Washington inland waters (e.g., Discovery Bay), Pacific herring was nominated for listing as threatened or endangered species and is currently under status review by NMFS¹.

Pacific herring use SMV along the Cherry Point shoreline for spawning, which occurs in the late spring to early summer from mid-March extending into June. The spawning peak is in late April or early May (EVS 1999). Fertilized eggs are deposited on SMV and incubate for approximately 14 days. Larvae spend approximately 10 days to two weeks in nearshore waters seeking refuge from predators and feeding in submerged vegetation beds. During this time, these larvae are winnowed out of nearshore waters by strong tidal currents. After metamorphosis, the juveniles use open waters of the Strait of Georgia and perhaps the Strait of Juan de Fuca for feeding. Current theory holds that the juveniles migrate to the West Coast of Vancouver Island where they mingle and mature with the British Columbia herring stocks (Kyte et al. 1999b, EVS 1999). After approximately 2 years, the adult herring return to spawn at Cherry Point.

Because of the importance of Pacific herring to federally listed species and the fact that the species uses the same habitats as threatened juvenile salmonids, the results of the 1999 SLERA (EVS 1999) are briefly discussed here. The SLERA concluded that the following stressors could be important (rated moderate or high) contributors to trends in Cherry Point herring populations.

- Temperature effects on eggs, larvae, juveniles, and adults.
- Food supplies for juveniles and adults.
- Predation on juveniles and adults.
- Organic contaminants effects on eggs, larvae, and spawning adults (included because of the lack of data on existing concentrations and the known effects on herring embryos).

The SLERA further listed the following stressors as having low or negligible contributions to trends of Cherry Point herring populations.

- Salinity effects on all life stages
- Dissolved oxygen effects on all life stages
- Lack of vegetation and substrate for eggs, larvae, juveniles, and spawning adults
- Disease effects on all life stages (a lack of data was noted)

¹ Federal Register, Volume 64, No. 118, pages 33037 – 33040.

- Fishing effects on eggs, juveniles, and adults
- Wave sheltering and modification of littoral processes effects on eggs, larvae, and spawning adults
- Light shading effects on eggs, larvae, juveniles, and spawning adults
- Vessel traffic, noise, ballast water, and disturbance effects on eggs, larvae, juveniles, and spawning adults
- Inorganic contaminant effects on eggs, larvae, and spawning adults (screened out as a stressor)
- Turbidity effects on eggs and larvae

In addition to Pacific herring, surf smelt (*Hypomesus pretiosus*) use beaches north of the ARCO Marine Terminal and south of Cherry Point within the project action areas for spawning from June through August (Habitat Management Division 1992; WDFW 1998, 2000). Pacific sand lance (*Ammodytes hexapterus*), another important forage fish species, is not known to use the Cherry Point shoreline for spawning (WDFW 1998, 2000).

A variety of salmonids are known to occur along the Cherry Point shoreline. Specific information on the salmonid use of marine waters in the Cherry Point vicinity is limited. However, what information is available confirms the use of this area by some species. Where information is lacking, general knowledge of the behavior and habitat preferences of salmonids in Puget Sound and the Strait of Georgia is used to infer habitat use by these species.

Miller et al. (1978) encountered large numbers of pink (*Onchorhynchus gorbusha*), chum (*Onchorhynchus keta*), coho (*Onchorhynchus kisutch*), and chinook (*Onchorhynchus tshawytscha*) salmon in the cobble habitats of the Cherry Point shoreline and in the protected eelgrass beds of Birch Bay. Juvenile sockeye salmon (*Onchorhynchus nerka*) were also found in Birch Bay but were generally less abundant than other species. The residence period for each species in these habitats was variable, but in general, juveniles were present from spring until fall when they presumably began their offshore migrations. Steelhead (*Onchorhynchus gairdneri*) were not noted in any samples for the Cherry Point vicinity, nor were sea-run cutthroat (*Onchorhynchus clarki*) or other trout species.

Adult chinook, pink, coho, and chum salmon migrating to the Fraser and Nooksack rivers and natal streams in Drayton Harbor can be expected to transit and feed along the Cherry Point shoreline, but the extent of this use has not been quantified. The historical operation of extensive fish traps in the Cherry Point vicinity indicates use of the Cherry Point vicinity as a migration pathway for Fraser River sockeye salmon (Kyte et al. 1999b). Sea-run cutthroat stocks have been identified in several tributaries to the Southeast Strait of Georgia. Because sea-run cutthroat are nearshore residents throughout much of their marine life and do not migrate extensively, they can be expected to be present in the Cherry Point vicinity year round.

The vicinity of the ARCO Marine Terminal also supports a variety of flatfish. During a 4-year study by Kyte (1994a) the following 10 species of flatfish were collected.

- | | |
|-------------------|----------------------------------|
| ■ Butter sole | <i>Pleuronectes isolepis</i> |
| ■ Dover sole | <i>Microstomus pacificus</i> |
| ■ English sole | <i>Pleuronectes vetulus</i> |
| ■ Flathead sole | <i>Hippoglossoides elassodon</i> |
| ■ Pacific sanddab | <i>Citharichthys sordidus</i> |

■ Rex sole	<i>Errex zachirus</i>
■ Rock sole	<i>Pleuronectes bilineata</i>
■ Sand sole	<i>Psettichthys melanostictus</i>
■ Slender sole	<i>Eopsetta exilis</i>
■ Starry flounder	<i>Platichthys stellatus</i>

Trawl data and scuba observations by Kyte (1994a) from the vicinity of the ARCO pier and other nearshore waters along the Cherry Point shoreline indicate that the flatfish populations in the action areas consist mostly of juvenile fish. Nearly all the flatfish caught in trawls were juveniles as indicated by their length (less than 6 inches). Only rarely was an adult flatfish of any species seen during the scuba or trawl sampling.

The sanddab was the most abundant flatfish species in the vicinity of the ARCO pier throughout the study. English sole was the only commercially important species taken in any substantial quantity in this study. Catches of this species were almost entirely juveniles and generally relatively low. English sole catches also displayed a definite periodicity with higher catches consistently in the fall, probably when recruitment from spring spawning occurred.

Marine Birds and Mammals

The Cherry Point shoreline also supports a variety of marine birds and mammals. In addition, the bald eagle (*Haliaeetus leucocephalus*) uses the marine habitats along the Cherry Point shoreline for feeding (Eissinger 1994). Eissinger, ENSR (1995), and WDFW (1998, 2000) documented the presence of the following bird species in the vicinity of Point Whitehorn and Cherry Point, between which lies the ARCO Marine Terminal.

■ Red-throated loon	<i>Gavia stellata</i>
■ Pacific loon	<i>Gavia pacifica</i>
■ Yellow-billed loon	<i>Gavia adamsii</i>
■ Harlequin duck	<i>Histrionicus histrionicus</i>
■ Oldsquaw	<i>Clangula hyemalis</i>
■ Black scoter	<i>Melanitta nigra</i>
■ Surf scoter	<i>Melanitta perspicillata</i>
■ White winged scoter	<i>Melanitta fusca</i>
■ Glaucous winged gull	<i>Larus glaucescens</i>
■ Bonaparte's gull	<i>Larus philadelphia</i>
■ Mew gull	<i>Larus canus</i>
■ Ring-billed gull	<i>Larus delawarensis</i>
■ Thayer's gull	<i>Larus thayeri</i>
■ Marbled murrelet	<i>Brachyramphus marmoratus</i>
■ Pigeon guillemot	<i>Cepphus columba</i>
■ Common murre	<i>Uria aalge</i>
■ Brandt's cormorant	<i>Phalacrocorax penicillatus</i>
■ Horned grebe	<i>Podiceps auritus</i>
■ Western grebe	<i>Aechmophorus clarkii</i>
■ Pied-billed grebe	<i>Podilymbus podiceps</i>
■ Semipalmated sandpiper	<i>Calidrus pusilla</i>
■ Dunlin	<i>Caladris alpina</i>
■ Killdeer	<i>Charadrius vociferus</i>
■ Belted kingfisher	<i>Ceryle alcyon</i>
■ Bald eagle	<i>Haliaeetus leucocephalus</i>
■ Peregrine falcon	<i>Falco peregrinus</i>

In addition to marine birds, a variety of marine mammals use the Southeast Strait of Georgia. Mammals known to occur along the Cherry Point shoreline include the following species (Eissinger 1994, Everitt et al. 1980).

- | | |
|---------------------------|--|
| ■ Harbor seal | <i>Phoca vitulina</i> |
| ■ Pacific harbor porpoise | <i>Phocoena phocoena</i> |
| ■ California sea lion | <i>Zalophus californianus</i> |
| ■ Gray whale | <i>Eschrichtius robustus</i> (sighting by this author) |

These species use the project action areas for feeding. Harbor seals use the rocky beaches for hauling out and pupping from Point Whitehorn south to within about 1 mile north of the ARCO Marine Terminal. There are no known breeding or haulout sites for sea lions in the Cherry Point vicinity. The nearest haulout location for sea lions is on Sucia Island, about 9 miles southwest of Cherry Point (Norberg 2000). Harbor seals also use this site and Point Migley on Lummi Island to the south (Everitt et al. 1980). The Cherry Point shoreline is likely generally unsuitable for sea lion haulout or use by whales because of the large areas of shallow water near shore.

LISTED AND CANDIDATE SPECIES

In March 2000, as the designated representative for the ARCO Cherry Point Refinery for preparation of this BE, BERGER/ABAM requested lists of federally protected species and priority habitats and species within the project area from USFWS, NMFS, WDNR, and WDFW. In addition, the threatened and endangered species internet web pages maintained by USFWS, NMFS, and WDFW were consulted. BERGER/ABAM received verbal confirmation of the listed and candidate species for which NMFS is responsible from NMFS on 29 February 2000 (Donnelly 2000) and 6 March 2000 (Norberg 2000). This information was supplemented with a Priority Habitat and Species report for the Cherry Point shoreline from Birch Point to Lummi Bay obtained from WDFW in 1998 and March 2000 (WDFW 1998, 2000). The following list of federally listed and candidate species that are known or could occur within the project area was compiled from these sources for the preparation of this BE.

- Chinook salmon (*Oncorhynchus tshawytscha*) – Threatened
- Coho salmon (*Oncorhynchus kisutch*)
- Bull trout (*Salvelinus confluentus*) – Threatened
- Humpback whale (*Megaptera novaeangliae*) – Endangered
- Leatherback sea turtle (*Dermochelys coriacea*) – Endangered
- Steller sea lion (*Eumetopias jubatus*) – Threatened
- Bald eagle (*Haliaeetus leucocephalus*) – Threatened
- Marbled murrelet (*Brachyramphus marmoratus*) – Threatened

DESCRIPTION OF SPECIES AND HABITAT

Chinook Salmon — Puget Sound Evolutionarily Significant Unit (ESU): Threatened

Chinook salmon may occur in the action areas and in the project vicinity both as adults and juveniles. The nearest stream used by chinook salmon for spawning is the Nooksack River (Williams et al. 1975). Adult chinook salmon would only be expected to use offshore waters for feeding or during migration. Adult fish could be expected to be in the vicinity of the project area from March through October, including both runs (Myers et al. 1998, Williams et al. 1975).

Juveniles of either type of chinook salmon, ocean or stream, would be expected to use the nearshore habitat in the project action area, especially the eelgrass beds, for feeding and refuge during migrations (Phillips 1984). These juveniles could be expected in the project area from March through August (Williams et al. 1975, Thom et al. 1989).

Coho Salmon — Puget Sound/Strait of Georgia ESU: Candidate

The nearest stream known to be used by coho salmon for spawning is Terrell Creek, a tributary to Birch Bay (Figure 2) (Williams et al. 1975). Juvenile coho salmon would be expected in the nearshore waters, especially the eelgrass beds, in March through July (Weitkamp et al. 1995). These juveniles, as with the young chinook salmon, would use the eelgrass beds and other nearshore habitats for feeding, a migration corridor, and shelter from predators.

Bull Trout: Threatened

Bull trout in Puget Sound streams exhibit four life history strategies: anadromous, adfluvial (using lakes and streams), fluvial (moving between or among different stream systems), and resident (staying in one drainage for their entire life span). Even though there are no known populations of bull trout within the project action areas, it is possible that adult bull trout from the Nooksack River or other streams could occur in the marine waters of the action area. These adults could use nearshore waters and habitats for feeding.

Steller Sea Lion: Threatened

Steller sea lions use all of Washington's marine and estuarine waters for feeding and resting. Their typical habitat is rocky or mixed beaches in isolated areas that are used for haulouts and feeding (Everitt et al. 1980, Gardner 1981). The nearest known haulout area used by Steller sea lions is on Sucia Island, approximately 9 miles southwest of the ARCO Marine Terminal (Norberg 2000, Everitt et al. 1980). The only other regular haulout site in the inland waters of the Puget Sound region known to be used by Steller sea lions is on Race Rocks in the Strait of Juan de Fuca (Everitt et al. 1980, Norberg 2000). It is possible that sea lions may use offshore waters of the project area for occasional feeding. They would be most likely to be present in the early fall to early spring (Everitt et al. 1980).

Humpback Whale: Endangered

Humpback whale sightings are a common occurrence along the Washington outer coast, with occasional sightings in the Strait of Juan de Fuca (Everitt et al. 1980). There have been only two or three sightings in Washington inland waters in the last 10 years (Norberg 2000).

Leatherback Sea Turtle: Endangered

Leatherback sea turtles have a global distribution and have been recorded as far north along the eastern Pacific coast as Alaska (Mager 1985 as cited in Cooke et al. 2000). Sea turtles nest in tropical regions and only occasionally forage into more northern and colder waters. Sightings in Washington waters have been rare with only one or two unconfirmed sightings off the outer coast of Washington in the last 10 years (Norberg 2000). It is highly unlikely that this species would occur in the project action areas.

Bald Eagle: Threatened

According to WDFW (1998, 2000), active eagle nests are located along the Cherry Point shoreline within the project action areas (Birch Point to Sandy Point) on Birch Point, in Birch Bay, on Point Whitehorn, on Alcoa/Intalco property, and at the north end of Lummi Bay inland of Neptune Beach. The nearest nest to the ARCO Marine Terminal and the project construction site is on Point Whitehorn, approximately 2 miles north of the project site (WDFW 1998, 2000). The next closest nest is to the south approximately 3 miles on the property of Alcoa/Intalco. In addition, eagles use the beaches and bluffs in the vicinity of the marine terminal and to the south for foraging.

Bald eagles primarily eat fish and sometimes feed on waterfowl and carrion (Watson and Pierce 1998). Generally 78 percent of an eagle's diet consists of fish, 19 percent of other birds, and 3 percent of mammals. As primarily fish-eaters, the birds usually nest within 1.6 miles of open water. Their home range in Washington averages 2.6 square miles (Watson and Pierce 1998). Because of their reliance on fish, it is likely that eagles use the project area for foraging. In fact, eagles have been sighted and have been listed for the Cherry Point area by Eissinger (1994).

ENSR (1995) reported bald eagles perching in trees or flying along the bluffs behind shore in the vicinity of the ARCO Marine Terminal. Eagles were not observed closer than about a half mile to the existing pier and left the area in August during the study.

Marbled Murrelet: Threatened

Marbled murrelets occur along the north Pacific coast from the Aleutian Islands and southern Alaska south to Central California (USFWS 1997). In the Pacific Northwest, murrelets live near shore feeding on fish and invertebrates and nesting in stands of mature and old growth forest. Puget Sound waters are heavily used by murrelets during the summer breeding season to obtain food (USFWS 1997). Preferred prey appears to be forage fish, especially Pacific herring and sandlance (*Ammodytes hexapterus*). Critical habitat for the marbled murrelet includes areas within a half mile of mature or old growth trees that are, or could be, used as nesting sites. This habitat does not occur in the suburban and rural environment in general vicinity of the ARCO Cherry Point Refinery, Ferndale, and Blaine.

ENSR (1995) conducted a study on the use of the ARCO Marine Terminal vicinity by marbled murrelets and other marine birds in 1995. During this study, up to nine murrelets or less because of possible resightings of resident individuals were observed using the "deepwater zone" defined by ENSR as that portion of the study area 1,300 to 2,300 feet from shore. This zone includes the existing and new vessel moorage locations at the ARCO Marine Terminal. These birds were seen from late July through late September. Prior to this study, surveys conducted in 1993 found no murrelets in the vicinity of the ARCO Marine Terminal (ENSR 1995).

ANALYSIS OF EFFECTS

Direct Effects

Construction of the new pier addition at the ARCO Marine Terminal will involve pile driving using a vibratory hammer to the extent possible and assembly of preconstructed pile cap, deck, and piping modules. As noted previously, all construction activities will take place offshore approximately 1,500 to 2,000 feet seaward of the ordinary high waterline and below all areas supporting SMV. Potential direct effects are listed below.

- Accidental spills of petroleum products could occur in conjunction with machinery operation. Potential impacts depend on the effectiveness of prevention measures and containment and cleanup procedures.
- The physical process of pile driving and other construction activities could impact fish and invertebrates in the near vicinity or at the locations of the construction. Potential impacts of these actions depend on whether fish or invertebrates are present and would be transmitted through underwater noise, actual impact with the piling, or excessive turbidity.
- Noise from construction could disrupt the foraging activities of marine birds and mammals and the reproductive activities of Pacific herring if the noise were to occur in the same time frame as the reproductive activities.

Accidental Spills

The construction contractor currently has in place a "Pollution Response Plan" and a "Shipboard Oil Pollution Emergency Plan" approved by the U.S. Coast Guard. These plans will be used for the duration of the project. These plans identify potential spill sources on the construction vessels. The plans specify responsive actions in the event of a spill or release and identify notification and reporting procedures. The plans outline what measures shall be taken by the contractor to prevent the release or spread of hazardous materials from the construction vessels.

Due to the precast and modularized design of this project, the bulk of the concrete pours, welding, and painting will take place on shore and not over water. Some tie-in welding and touch up painting will take place over water. Tarps or other protective barriers will be used to prevent foreign materials from entering the water.

Fish and Invertebrates

The pier addition construction will directly impact sedentary and sessile species that cannot avoid the construction activities. These include infauna, such as worms, clams (e.g., geoducks), small crustaceans, etc., and epifauna such as sea cucumbers and seastars either struck by the edges of the cylindrical steel piling and caissons or trapped inside the piling and caissons during driving. Any organisms caught inside the piling or caissons will eventually die from lack of oxygen because the piling walls will prevent any water circulation. Most finfish and crabs will be able to move away from the disturbance during the piling and caisson location procedure.

It should be noted that the populations of geoducks in the Cherry Point to Point Whitehorn area are not commercially harvested and are not listed as a commercial tract by WDFW (Sizemore et al. 1999).

As discussed previously, Pacific herring are an important food source for listed and candidate salmonids and marbled murrelets. Construction activities and subsequent operation of the pier addition could generate turbidity, noise, and disturbances from vessel movements and anchoring during construction that would be harmful to herring. The 1999 SLERA assessed these potential impacts and others to the Cherry Point Pacific herring population. Turbidity, noise, and vessel activity were rated as "negligible" or "negligible to low" contributions to the decline of the Cherry Point herring populations (EVS 1999: Table 5-3). In addition, because all on- and inwater construction activities will be restricted to areas well offshore of existing SMV habitats and outside of the herring spawning season, no significant impact to herring spawning activities or habitats is expected.

Listed and Candidate Species

Direct impacts to listed and candidate species may originate primarily from the noise and human activity associated with pile driving and construction. The effects of pile driving on juvenile salmonids will be greatly reduced due to the distance offshore of SMV habitats used by salmonids during migrations. In addition, the effects from noise will be substantially reduced through timing restrictions. Adult salmonids may be in the area as they migrate to their natal streams, but are highly mobile and can easily avoid the construction area. Adult salmonids can be adjacent to piles while they are driven without suffering apparent harm or dramatic behavioral changes such as delayed migration (Grette 1985 as cited in Cooke et al. 2000).

The nearest bald eagle nests are 2 and 3 miles away (WDFW 1998, 2000) and are not expected to be impacted by the noise from construction. Foraging eagles can easily avoid the vicinity of the construction site. In addition, construction activities will occur 1,000 to 2,000 feet offshore of the bluffs and nearshore habitats preferred for perching and foraging, respectively.

Marbled murrelets foraging in the Cherry Point shoreline will also be able to easily avoid the construction site. ENSR (1995) indicated that only a few murrelets use the project action area as defined in this BE, and that these birds would be able to find suitable feeding and "loafing" habitat to the north and south of the ARCO Marine Terminal during construction. ENSR (1995) also indicated concurrence with their findings by Lummi Nation biologists.

Indirect Effects

Indirect effects could include impacts from turbidity generated by inwater construction activities, wave sheltering from the new pier, and effects from the subsequent ship traffic at the new wing including noise, physical disturbance, and oil spills. In addition, any direct impacts on the Cherry Point Pacific herring population would indirectly affect listed and candidate salmonid and bird species. This effect was discussed in the previous section on direct effects.

It is expected that sediments will be suspended during location of the caissons and piling and during setting and removal of anchors. This turbidity will likely be short in duration (less than an hour) and low in concentration because jetting and excavation techniques are not planned to be used to place the piling and caissons and because of the predominantly sandy composition of the sediments in the construction action area. In addition, the relatively strong tidal currents will rapidly disperse any turbidity generated by construction activities. Because of the factors of low concentration of fine sediments (silt and clay) and tidal currents, it is unlikely that turbidity will have direct or indirect effects on benthic assemblages or demersal or pelagic fish (i.e., herring or salmonids) in the action area.

Wave sheltering from the new pier addition and the vessels moored to it could affect littoral processes along the shoreline in the vicinity of the ARCO Marine Terminal. These effects could, in turn, affect SMV and shoreline morphology, impacting Pacific herring and juvenile salmonid habitat. This effect was discussed by the herring SLERA (EVS 1999). The SLERA stated that the contribution of wave sheltering as a stressor to the decline of Pacific herring was "negligible to low" (EVS 1999: Table 5-3). EVS cited studies for other proposed marine terminal facilities along the Cherry Point shoreline (e.g., Gateway Pacific) that found that the proposed facilities would have a low potential for wave sheltering or sedimentation effects.

As discussed previously, ARCO projects that vessel traffic associated with the Marine Terminal will increase to an estimated 330 vessels by the year 2002, a 13 percent increase over 1999 traffic levels. It should be noted that this increase has already occurred because of the temporary need for

additional petroleum shipments due to the recent Olympic pipeline incident, which disrupted normal shipping procedures from the Cherry Point refineries (Payne 2000).

This vessel traffic could cause noise, disruption from vessel movements, and risk of oil spills. On the other hand, operation of two berthing locations will separate vessel arrival and departure, thus improving traffic separation and efficiency and safety of shipping operations. The risk of oil spills will be decreased by reducing the total time that petroleum carriers spend on-water within Puget Sound, as well as reducing traffic congestion caused by petroleum carriers and their tug escorts.

The effects of noise and vessel movements were addressed in the previous section in relation to Pacific herring. It can be assumed since herring have been shown to be sensitive to environmental disturbance (EVS 1999) that this species would be a good indicator of the sensitivity of listed and candidate species to these indirect effects. Thus, it is unlikely that noise and other disturbances from the increased vessel traffic would have indirect effects on listed or candidate species in the indirect effects action area.

Oil spills from vessels using the ARCO Marine Terminal could affect listed and candidate species and their environment. This effect was addressed by the 1999 SLERA for Pacific herring which found the additional risk from oil spills to be negligible to low. In addition, ENSR (1995) discussed this risk in relation to marbled murrelets. This report and the 1999 SLERA (EVS 1999) concluded that the risk to marbled murrelets and, by association, to other listed and candidate species is low when it is considered that in nearly 30 years of operation there has been a very low incidence and volume of spills from the ARCO Marine Terminal.

In addition, there have been two oil spills recently from the Tosco Marine Terminal to the south of ARCO. Wind and tidal currents carried one of these (1999) to the vicinity of the ARCO facility and Point Whitehorn. The other (1997) was transported to the south to the vicinity of Lummi and Vendovi islands. Natural Resource Damage Assessments on both spills found negligible damage and no sea birds of any species were harmed (Paris 2000).

Cumulative Effects

Within the indirect effects action area there are three marine terminals, ARCO, Alcoa/Intalco, and Tosco, as previously discussed. The ARCO Marine Terminal addition will not add to this number but will only expand the moorage sites at the existing terminal. As discussed previously under indirect effects, vessel traffic associated with ARCO's Marine Terminal is projected to increase by 13 percent from 1999 to 2002 (Payne 2000). As previously noted, this increase has already occurred on a temporary basis because of the Olympic Pipeline shutdown and therefore is not dependent on the pier addition.

When considering potential and likely future developments, it appears likely that another marine terminal will be constructed to the south of ARCO and Cherry Point by Gateway Pacific for the purpose of transshipping bulk commodities. The addition of this facility would probably significantly increase vessel traffic in the Southeast Strait of Georgia from an average of two large commercial vessel movements per day to three movements per day (KJS Associates, Inc. 1996).

Studies by ENSR (1992, 1995, 1997) and EVS (1999 SLERA) showed that the ARCO pier addition is unlikely to have significant direct, indirect, or cumulative effects within the project action areas. This pier addition will not result in a long-term increase in cumulative effects or significant changes to baseline conditions since it will not significantly increase vessel traffic within the Southeast Strait of Georgia nor will it increase the number of industrial facilities on the Cherry Point shoreline. However, the addition of the Gateway Pacific facility with that of the ARCO pier addition may result in long-term cumulative effects because of the significant increase in vessel traffic.

Interdependent/Interrelated Effects

There are no interdependent/interrelated effects identified. As a result, changes to baseline conditions are unlikely. The new pier wing could afford future opportunities for ARCO. One such opportunity that has been proposed is calcined coke product shipment across the new pier addition. However, ARCO does not currently have this project as part of their 3 to 5-year long range plan. Such a project would be independently permitted through the Corps if it is pursued in the future.

MANAGEMENT ACTIONS RELATED TO THE SPECIES

The only component of the project that may influence listed and candidate species in the project action areas is construction. Effects from construction will be largely avoided and minimized through timing and design of the facility. No critical habitat for any listed or candidate species will be directly or indirectly impacted. As discussed previously, all construction activities on or inwater will be restricted to summer and fall seasons from 15 June to September or October. Specifically, there will be no inwater construction activities within the herring spawning season, April to June; within the period when outmigrating salmonids may be present, March through mid-June; or within most of the bald eagle nesting season, January to mid-June. In addition, all construction activities including anchoring will be restricted to deep water and will avoid all SMV and nearshore (less than -20 feet MLLW) habitats. The pier addition has been designed to minimize pile driving and other inwater work by using larger diameter piling and caissons, precast piling caps, and decking and piping modules to avoid overwater concrete pouring and excessive welding, painting, and other activities that could result in contamination of the marine waters. Thus, mitigation or other additional management actions related to listed and candidate species are not anticipated.

CONCLUSIONS AND DETERMINATIONS

As shown in previous discussions of effects, the ARCO Marine Terminal planned pier addition will avoid or minimize all direct and indirect effects to listed, candidate, and associated species (e.g., Pacific herring). Thus, the following effect determinations are *recommended*.

Chinook Salmon: Threatened

A *recommended* determination of *may affect*, but is not likely to adversely affect is made for chinook salmon. The principal source of impact to chinook salmon could be through noise from construction. However, this effect will be mostly avoided by scheduling construction during summer and fall months when juvenile chinook salmon are not present. Additional effects from temporary turbidity and marine terminal operation are considered discountable and insignificant and will not result in "take."

Coho Salmon: Candidate

A *recommended* determination of *no jeopardy* is made for coho salmon. If listed, the *recommended* determination would be *may affect*, but is not likely to adversely affect for the same reasons as discussed for chinook salmon.

Bull Trout: Threatened

A *recommended* determination of *may affect*, but is not likely to adversely affect is made for bull trout. Even though there are *no known* populations of bull trout that use the project action areas, it is possible that adult bull trout from other rivers in the region could occur in the marine

waters of the action areas. These adults could use nearshore waters and habitats for feeding and be temporarily disturbed by the pier construction. Effects on bull trout from turbidity, construction noise, and marine terminal operation are discountable and insignificant.

Steller Sea Lion: Threatened

A *recommended* determination of **no effect** is made for Steller sea lions. The pier addition construction or operation will not affect feeding, resting, or breeding habitat or resources for Steller sea lions.

Humpback Whale: Endangered

A *recommended* determination of **no effect** is made for humpback whales. The pier addition construction or operation will not affect feeding, resting, or breeding habitat or resources for humpback whales since they have not been shown to occur in the project vicinity or action areas.

Leatherback Sea Turtle: Endangered

A *recommended* determination of **no effect** is made for leatherback sea turtles. The pier addition construction or operation will not affect feeding, resting, or breeding habitat or resources for leatherback sea turtles since they have not been shown to occur in the project vicinity or action areas.

Bald Eagle: Threatened

A *recommended* determination of **no effect** is made for bald eagles. The ARCO Marine Terminal pier addition construction and operation will not affect feeding, resting, or breeding habitat or resources for bald eagles. Because of the substantial distance to the nearest nesting location, temporary effects of noise and additional human presence are discountable and insignificant. In addition, Gossett (2000) stated that the Corps has previously determined that the project will have no effect on eagles.

Marbled Murrelet: Threatened

A *recommended* determination of **no effect** is made for marbled murrelets. There is no critical habitat for breeding in the vicinity of the ARCO Marine Terminal and use of the project action areas has been shown to be low. Thus, the pier addition construction or operation will not affect feeding, resting, or breeding habitat or resources for marbled murrelets. Because of the lack of critical habitat and the substantial distance to the nearest nesting habitat, temporary effects of noise and additional human presence are discountable and insignificant. In addition, Gossett (2000) stated that the Corps has previously determined that the project will have no effect on marbled murrelets.

REFERENCES

Atlantic Richfield Company. 1977. Trans Mountain Pipeline Project Environmental Assessment. Environmental assessment prepared relative to a permit application submitted to the U.S. Army Corps of Engineers. Appendix F.

Ardea Enterprises. 1989. Results of 1988 Biological and Chemical Monitoring in the Southeast Georgia Strait for the Atlantic Richfield Company Cherry Point Refinery. Submitted to the Atlantic Richfield Cherry Point Refinery by Shapiro and Associates, Inc., and Ardea Enterprises. February 1989.

- Battelle Pacific Northwest Laboratories. 1974. Field and Laboratory Studies to Obtain a Comparative Baseline for Assessing the Impact of Refinery Discharge and Potential Oil Spillage on the Cherry Point Environs. Volumes I through IV. Final report. Atlantic Richfield Company Cherry Point Refinery, Ferndale, Washington.
- Cooke, L.R., T. McKenzie, and S. Visconty. 2000. Biological Assessment for Threatened and Endangered Species Listed by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. Taylor Avenue Dock Waterfront and Beach Access Project. City of Bellingham Parks and Recreation Department.
- Crecelius, E. 1998. Background Metals Concentrations in Selected Puget Sound Marine Receiving Waters. Prepared for Western States Petroleum Association. February 1998.
- Day, D.D. 1987. Changes in the Natural Mortality Rate of the SE Strait of Georgia Sac Roe Herring Spawning Stock, 1976-1985. WDF Technical Report No. 98.
- Eissinger, A.M. 1994. Significant Wildlife Areas, Whatcom County, Washington. Whatcom County Environmental Resources Report Series. Prepared for Whatcom County Planning and Development Services Planning Division. December 1994.
- Everitt, R.D., C.H. Fiscus, R.L. DeLong. 1980. Northern Puget Sound Marine Mammals. U.S. Department of Commerce, National Oceanic and Atmospheric Administration and U.S. Environmental Protection Agency. Report No. EPA 600/7-80-139.
- ENSR Consulting and Engineering. 1991. ARCO Products Company. Cherry Point Refinery, Blaine, Washington. Sediment Study Final Report. Prepared for the ARCO Cherry Point Refinery.
- ENSR Consulting and Engineering. 1992a. Environmental Report for the Dock Completion Project. Cherry Point Refinery, Whatcom County, Washington. Prepared for the ARCO Products Company. May.
- ENSR Consulting and Engineering. 1992b. Sediment Baseline Monitoring Report. ARCO Cherry Point Refinery. Prepared for the ARCO Products Company.
- ENSR Consulting and Engineering. 1995. Assessment of Marbled Murrelets and Other Marine Bird Use near the ARCO Marine Terminal. Report prepared for ARCO Products Company Cherry Point Refinery.
- ENSR Consulting and Engineering. 1997. Addendum to Environmental Documentation File #S21-91 - The ARCO Products Company Dock Completion Project. Prepared for the ARCO Cherry Point Refinery.
- Everitt, Robert D., Clifford H. Fiscus, and Robert L. DeLong. 1980. Northern Puget Sound Marine Mammals. Interagency Energy/Environment Research and Development Program Report. EPA-600/7-80-139.
- EVS Environment Consultants, Inc. 1999. Cherry Point Screening Ecological Risk Assessment. Prepared for the Washington Department of Natural Resources, Olympia, WA. July 1999.
- Donnelly, Robert. 2000. National Marine Fisheries Service. Personal communication with Michael A. Kyte, BERGER/ABAM Engineers Inc., 29 February 2000.

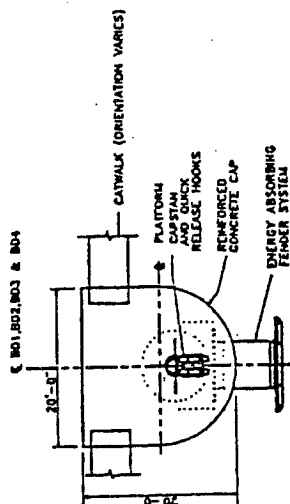
- Gardner, Fred (editor). 1981. Washington Coastal Areas of Major Biological Significance. Washington Department of Ecology Baseline Studies Program.
- Gossett, E.J. 2000. Draft Guidance. BE/BA Format – for Applicants. Version: 5 January 2000. E-mail to Michael Kyte, 13 March 2000.
- Habitat Management Division. 1992. Salmon, Marine Fish and Shellfish Resources and Associated Fisheries in Washington's Coastal and Inland Marine Waters. Washington Department of Fisheries.
- Hay, D., J. Schweigert, and G.A. Macfarlane. 2000. Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, BC. Personal communication to Michael Kyte, Anchorage, Alaska, 25 February 2000.
- Jeffries, Steven J., Robin F. Brown, Harriet R. Huber, Robert L. DeLong. 1997. Assessment of Harbor Seals in Washington and Oregon, 1996. National Marine Fisheries Service Alaska Fisheries Science Center Processed Report 97-10.
- KJS Associates, Inc. 1996. Gateway Pacific Terminal Transportation Impact Study. Final Report prepared for Pacific International Terminals, Bellingham, Washington. Appendix C in the Gateway Pacific Terminal Preliminary Draft Environmental Impact Statement, November 1996.
- Kyte, M. 1994a. The Use by Flatfish and Dungeness Crab of the Atlantic Richfield Company Cherry Point Refinery Facility. Project Final Report. Prepared for the ARCO Cherry Point Refinery. February 1994.
- Kyte, M. 1994b. Results of Biological and Chemical Monitoring in the Southeast Georgia Strait for the Atlantic Richfield Company Cherry Point Refinery. Prepared for The Atlantic Richfield Cherry Point Refinery, Blaine, Washington. Project Final Report. February.
- Kyte, M. 1994c. Results of Biological and Chemical Monitoring in the Southeast Georgia Strait for the Atlantic Richfield Company Cherry Point Refinery. Prepared by Pentec Environmental, Inc., for The Atlantic Richfield Cherry Point Refinery, Blaine, Washington. Project Final Report, Project No. 138-001. February.
- Kyte, M. 1996. A Final Vegetation Survey at the ARCO Cherry Point Refinery Pier. Report prepared for ARCO Products Company, Cherry Point Refinery.
- Kyte, Michael A., Sharon Rodman, Eric Doyle, Burt Shephard. 1999a. Cherry Point Annotated Bibliography, Version 2.0, March 15, 1999. Prepared for the ARCO Cherry Point Refinery, Alcoa Intalco Works, and the Tosco Ferndale Refinery.
- Kyte, Michael A., Sharon Rodman, Eric Doyle, Burt Shephard. 1999b. Cherry Point Literature Review. Prepared for the ARCO Cherry Point Refinery, Alcoa Intalco Works, and the Tosco Ferndale Refinery.
- Long, E.R. et al. 1999. Sediment Quality in Puget Sound. Year 1 – Northern Puget Sound. National Oceanic and Atmospheric Administration National Status and Trends Program Technical Memo No. 139.

- Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.
- National Marine Fisheries Service. 1999. A Guide to Biological Assessments. Revised March 23, 1999. Washington Habitat Conservation Branch, Lacey, Washington.
- Norberg, Brent. 2000. National Marine Fisheries Service, marine mammal specialist. Personal communication to Michael Kyte, BERGER/ABAM Engineers Inc., 6 March 2000.
- Nysewander, D.R. 1999. "Marine Bird and Mammal Component: Puget Sound Ambient Monitoring Program (PSAMP)." WDFW PSAMP marine bird and mammal data sets.
- Paris, S. 2000. Environmental Supervisor, Tosco Ferndale Refinery. Personal communication to Michael Kyte, BERGER/ABAM Engineers Inc., 21 March 2000.
- Payne, K. 2000. Manager, Environmental, Health & Safety. ARCO Cherry Point Refinery, Blaine, Washington. Personal communication by E-mail to Michael Kyte. 14 March 2000.
- Pentilla, Dan. WDFW Fish Biologist III. Forage Fish Unit. 1997. Telephone conversation with Michael Kyte, URS Greiner, Inc. Re: Forage Fishery Resources in the Des Moines area.
- Phillips, R. 1984. The Ecology of Eelgrass Meadows in the Pacific Northwest: A Community Profile. U.S. Fish and Wildlife Service report FWS/OBS - 84/24.
- Quinn, E. 2000. Superintendent. Manson Construction Co. Personal communication to Michael Kyte, BERGER/ABAM Engineers Inc. 8 March 2000.
- Sizemore, B., A. Bradbury, and L. MacGregor. 1999. 1999 Geoduck Atlas. Atlas of Major Geoduck Tracts of Puget Sound. Washington Department of Fish and Wildlife.
- Speich, S.M. 1995. Marbled Murrelet Populations of Washington: Marine Habitat Preferences and Variability of Occurrence. In: Ecology and Conservation of the Marbled Murrelet. Edited by C.J. Ralph, G.L. Hunt Jr., M.G. Raphael, and J.F. Piatt. General Technical Report Pacific Southwest Research Station No. 152.
- Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. 1989. Fish and Their Epibenthic Prey in a Marina and Adjacent Mudflats and Eelgrass Meadow in a Small Estuarine Bay. University of Washington Fisheries Research Institute Report FRI-UW-8901.
- U.S. Fish and Wildlife Service. 1997. Recovery Plan for the Threatened Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. Portland, Oregon. 203 pp.
- Washington State Department of Fish and Wildlife. 1998. Habitat and Species Report. Priority Habitats and Species. December 22, 1998.
- Washington State Department of Fish and Wildlife. 2000. Habitat and Species Report. Priority Habitats and Species. 17 March 2000.

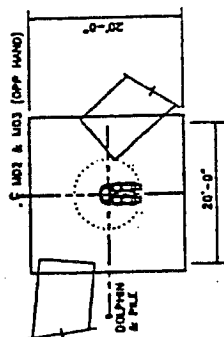
Watson, J.W., and D.J. Pierce. 1998. Ecology of Bald Eagles in Western Washington with an Emphasis on the Effects of Human Activity. Final Report. Washington State Department of Fish and Wildlife, Olympia, Washington.

Weitkamp, Laurie, Thomas C. Wainwright, Gregory J. Bryant, George B. Milner, David J. Teel, Robert G. Kope, and Robin S. Waples. 1995. Status Review of Coho Salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-24.

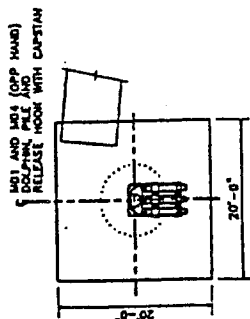
Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization. Volume 1. Puget Sound Region. Washington State Department of Fish and Wildlife.



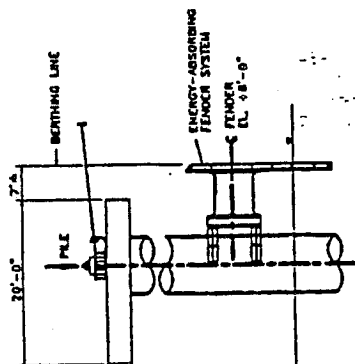
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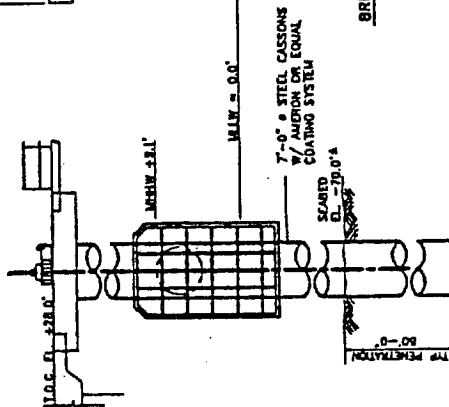
MOORING DOLPHIN PLAN



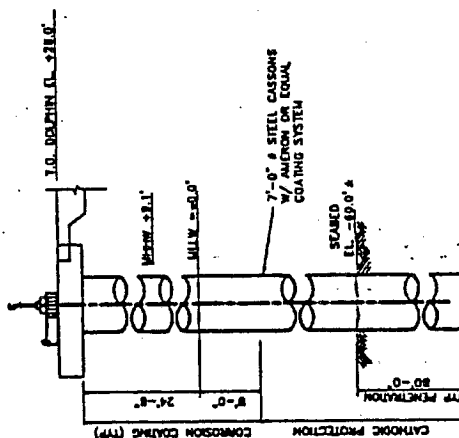
MOORING DOLPHIN PLAN



BREASTING DOLPHIN SIDE ELEVATION



BREASTING DOLPHIN FRONT ELEVATION



MOORING DOLPHIN TYPICAL ELEVATION

NOTE:
GENERAL:
1: ALL ELEVATIONS REFER TO MLLW ELEV. 0.0

92-1-00435

ENGINEERING CONTRACTOR:
ANVIL CORPORATION
BELLINGHAM, WA.

ACAD FILE #: 4116CD13.DWG
DATE: 01/31/00 11:01

PLAN AND SECTIONS-DOLPHINS

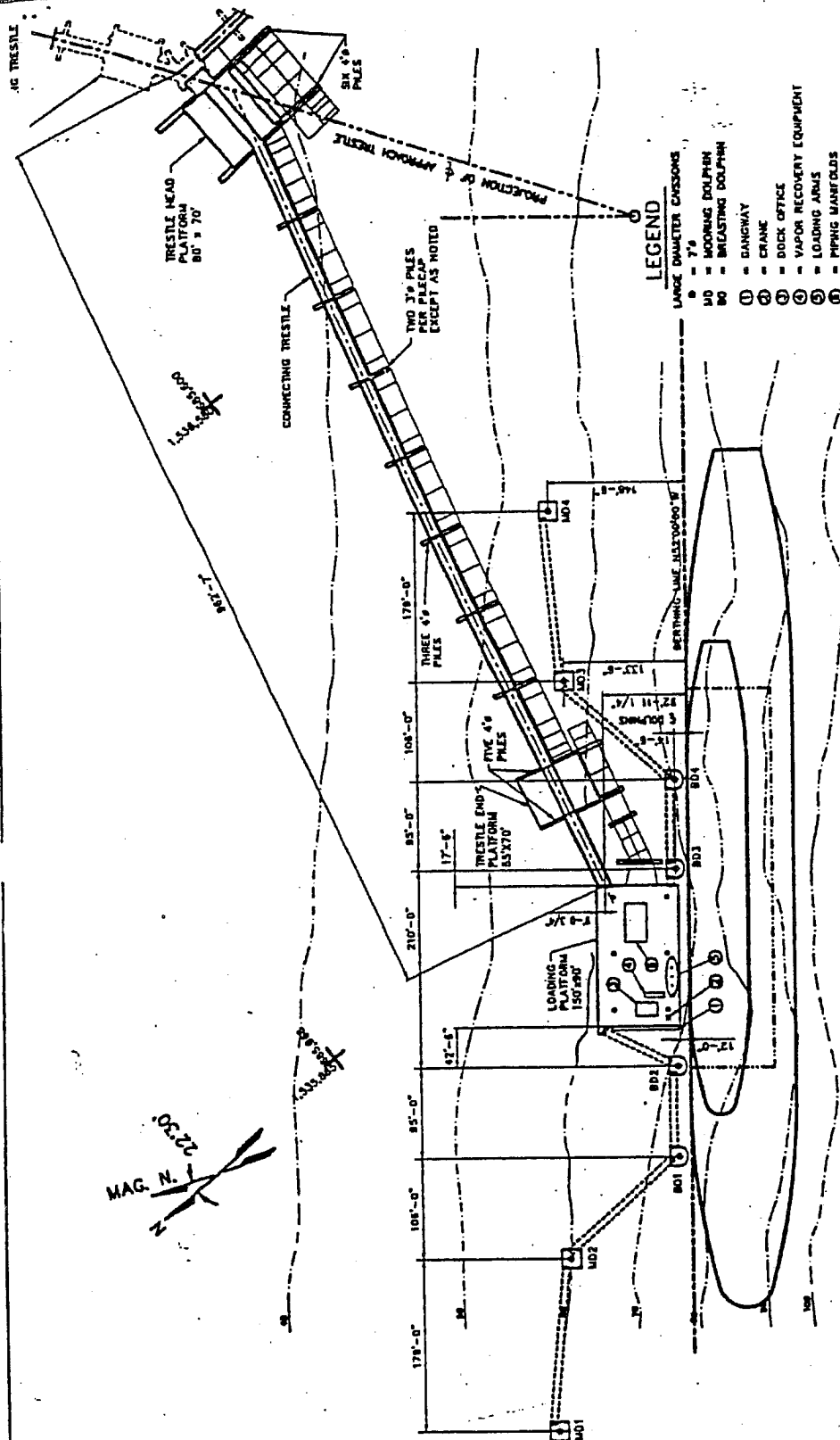
ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

PROPOSED DOCK, PILING, CONNECTING TRESTLE AND
DOLPHIN COMPLETION.

IN: STRAIT OF GEORGIA
NEAR: FERNDAL
COUNTY OF: WHATCOM; STATE, WA
APPLICATION BY: ARCO PRODUCTS CO.
CHERRY POINT REFINERY

SHEET 5 OF 10
REV 1

DATE: 10/15/91
DATE: 1/00



NOTES:

GENERAL

1. ALL ELEVATIONS REFER TO MLLW ELEV. 0.0
2. ALL CONTOURS ARE IN FEET AND REFER TO MLLW
3. ALL COORDINATES ARE IN WASHINGTON STATE LAMBERT GRID SYSTEM.

92-1-00435

ENGINEERING CONTRACTOR:
ANVL CORPORATION
 BELLINGHAM, WA
 ACAD FILE # 4116MD09.DWG
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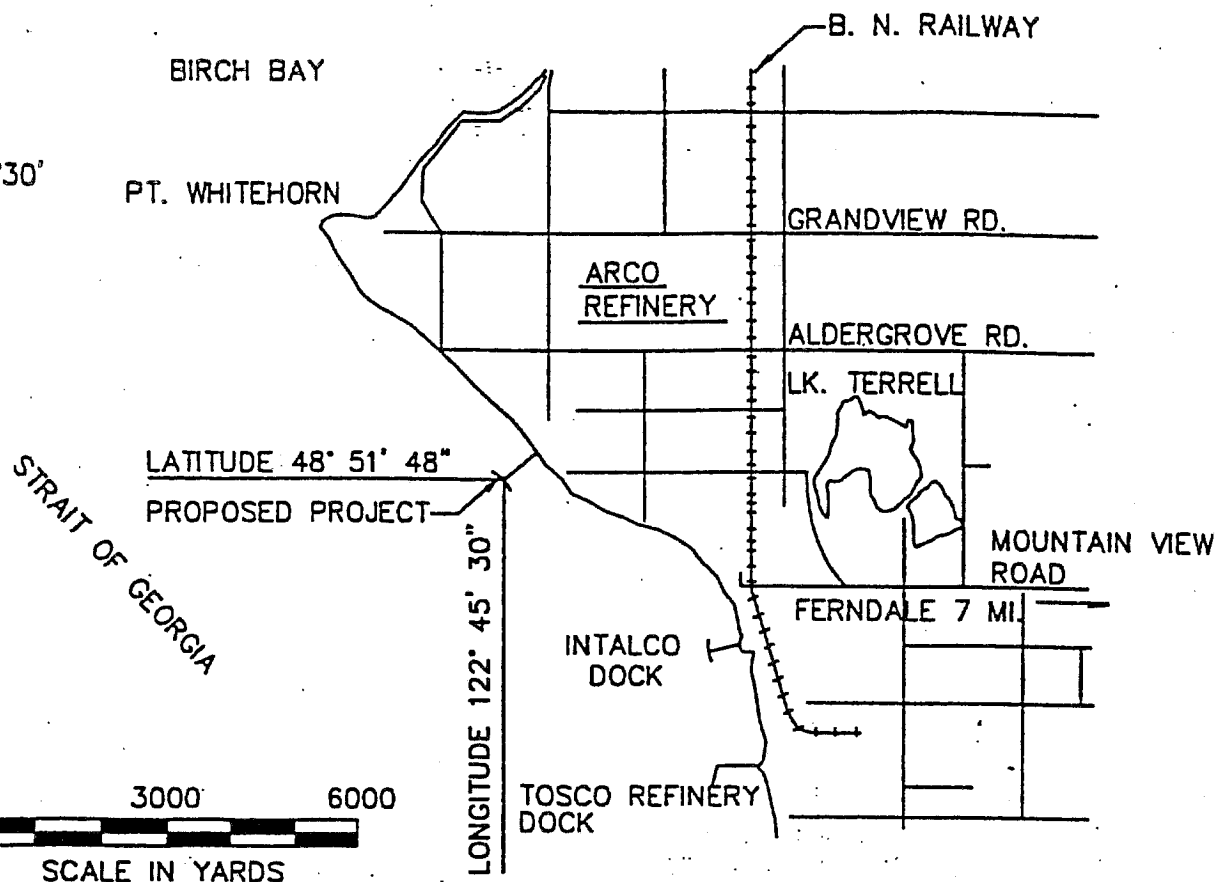
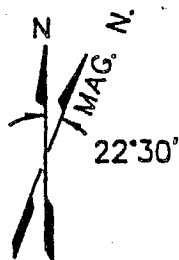
PLAN VIEW

ATLANTIC RICHFIELD COMPANY
 PRODUCTS DIVISION
 CHERRY POINT REFINERY

PROPOSED DOCK, PILING, CONNECTING
 TRESTLE AND DOLPHIN COMPLETION

W: STRAIT OF GEORGIA
 NEAR: FERNDALE
 COUNTY OF: WHATCOM; STATE, WA
 APPLICATION BY: ARCO PRODUCTS COMPANY
 CHERRY POINT REFINERY

SHEET 3 OF 10 DATE: 10-15-91
 REV 1 DATE: 1/00

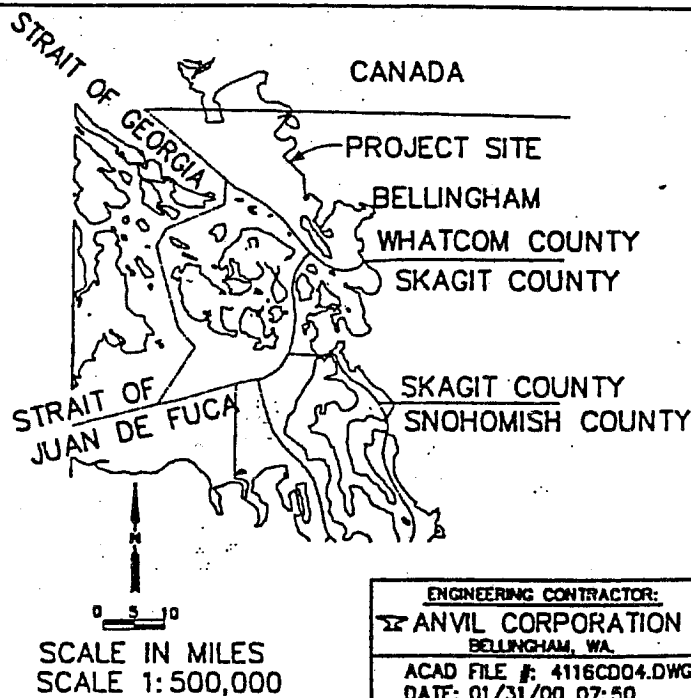


0 3000 6000
SCALE IN YARDS

NOTE:

- 1: REFERENCE: U.S.C. & G.S. CHART OF STRAIT OF JUAN DE FUCA AND STRAIT OF GEORGIA NO:6380; DATE: 6/10/72.

92-1-00435



SCALE IN MILES
SCALE 1:500,000

ENGINEERING CONTRACTOR:
ANVIL CORPORATION
BELLINGHAM, WA.
ACAD FILE #: 4116CD04.DWG
DATE: 01/31/00 07:50

PURPOSE: PETROLEUM PRODUCT LOADING/UNLOADING FACILITY. NO FEDERAL HARBOR LINES IN EFFECT.
DATUM: MEAN LOWER LOW WATER (MLLW)=0.00 N.O.S.
SOUNDINGS ARE IN FEET.

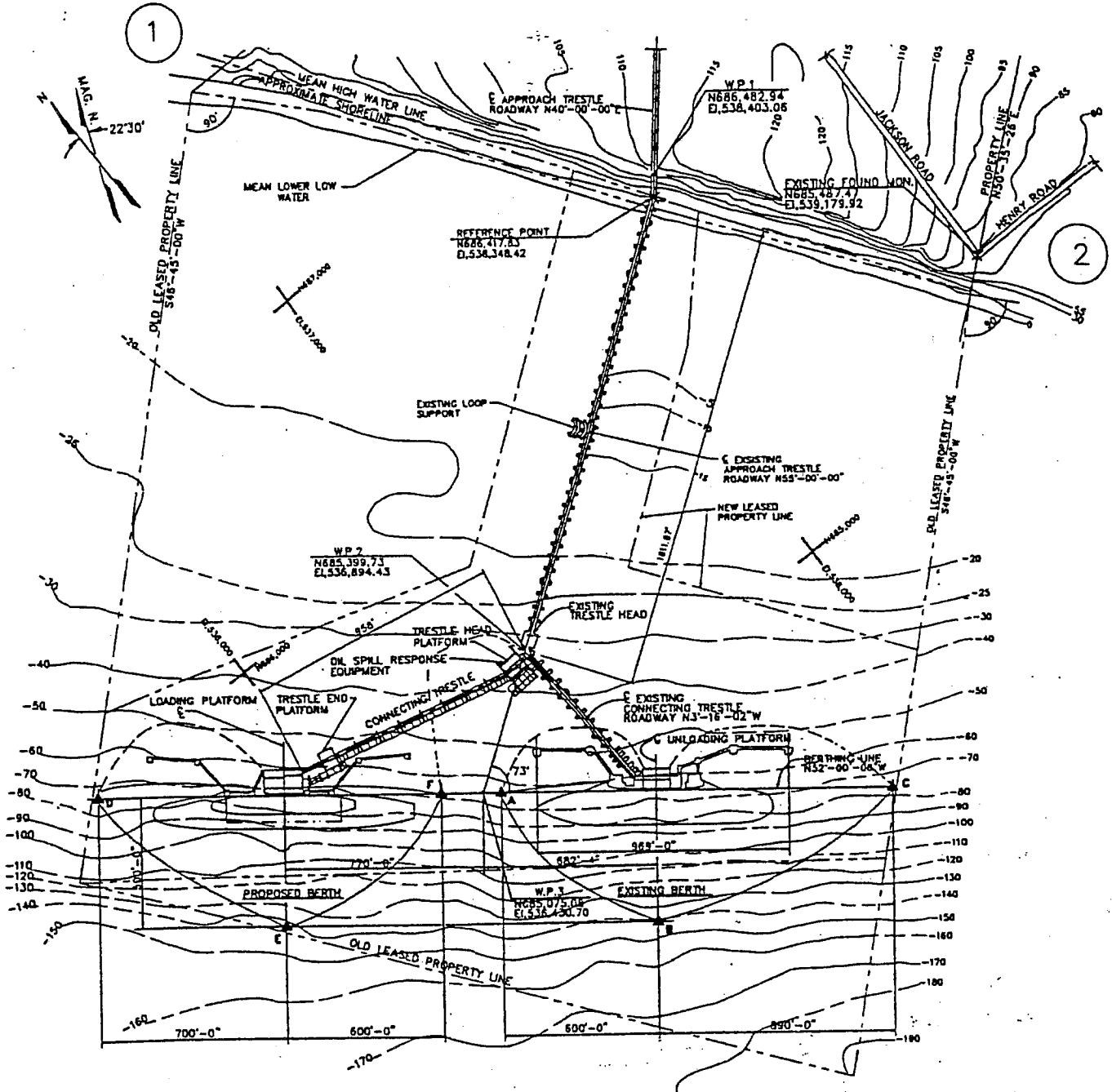
VICINITY MAP

ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

PROPOSED DOCK, PILING, CONNECTING TRESTLE AND DOUPHIN COMPLETION.

IN: STRAIT OF GEORGIA
NEAR: FERNDALE
COUNTY OF: WHATCOM; STATE, WA
APPLICATION BY: ARCO PRODUCTS CO.
CHERRY POINT REFINERY

SHEET 1 OF 10
REV 1
DATE: 10/15/91
DATE: 1/00



GENERAL NOTES

1. ALL ELEVATIONS REFER TO MLLW DLEX S.B.
2. MEAN HIGH WATER LINE IS 2.8' AS MEASURED AT LOW BAY.
3. ALL COORDINATES, BEARINGS, AND LEASED PROPERTY LINES ARE TAKEN FROM ARCO DWG. NO. AD-3500-103 REV. C DATED 12/12/75. ALL COORDINATES ARE IN WASHINGTON STATE LAMBERT GRID SYSTEM.
4. ▲ INDICATES PENCIL BUGY LOCATIONS
5. CONTAMINANT BOOM: ——— DEPLOYED, - - - - - STORED.

DREDGING

1. NO DREDGING REQUIRED

FILL

1. NO FILL REQUIRED

SITE PLAN



ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

ADJACENT PROPERTY OWNERS

① BURLINGTON NORTHERN RAILROAD
2100 FIRST INTERSTATE CENTER
999 3RD AVE.
SEATTLE, WA 98104

STANDARD OIL CO. OF CA.
225 BUSH STREET
SAN FRANCISCO, CA 94120

PROPOSED DOCK, PILING, CONNECTING TRESTLE AND
DOLPHIN COMPLETION.

IN: STRAIT OF GEORGIA
NEAR: FERDALE
COUNTY OF: WHATCOM; STATE, WA.
APPLICATION BY: ARCO PRODUCTS CO.
CHERRY POINT REFINERY

SHEET 2 OF 10
REV 1

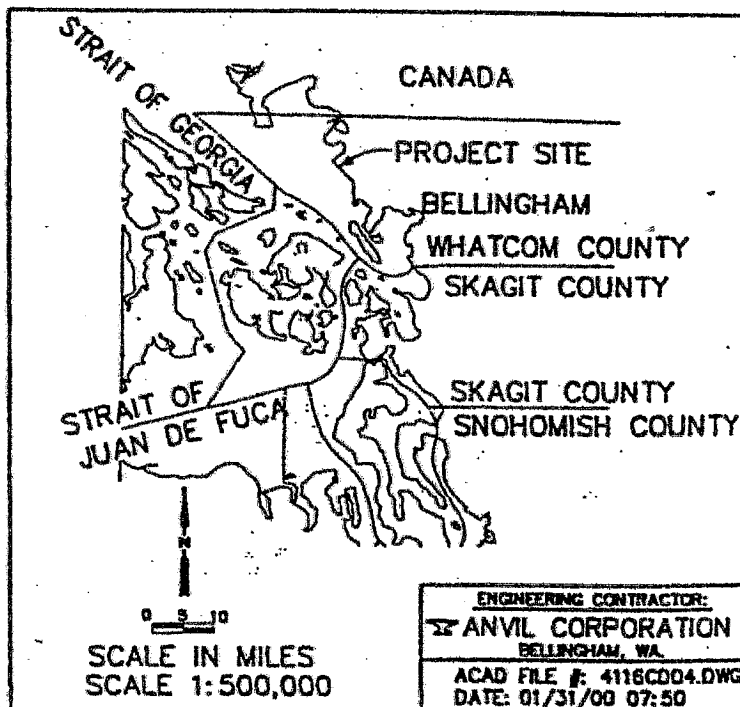
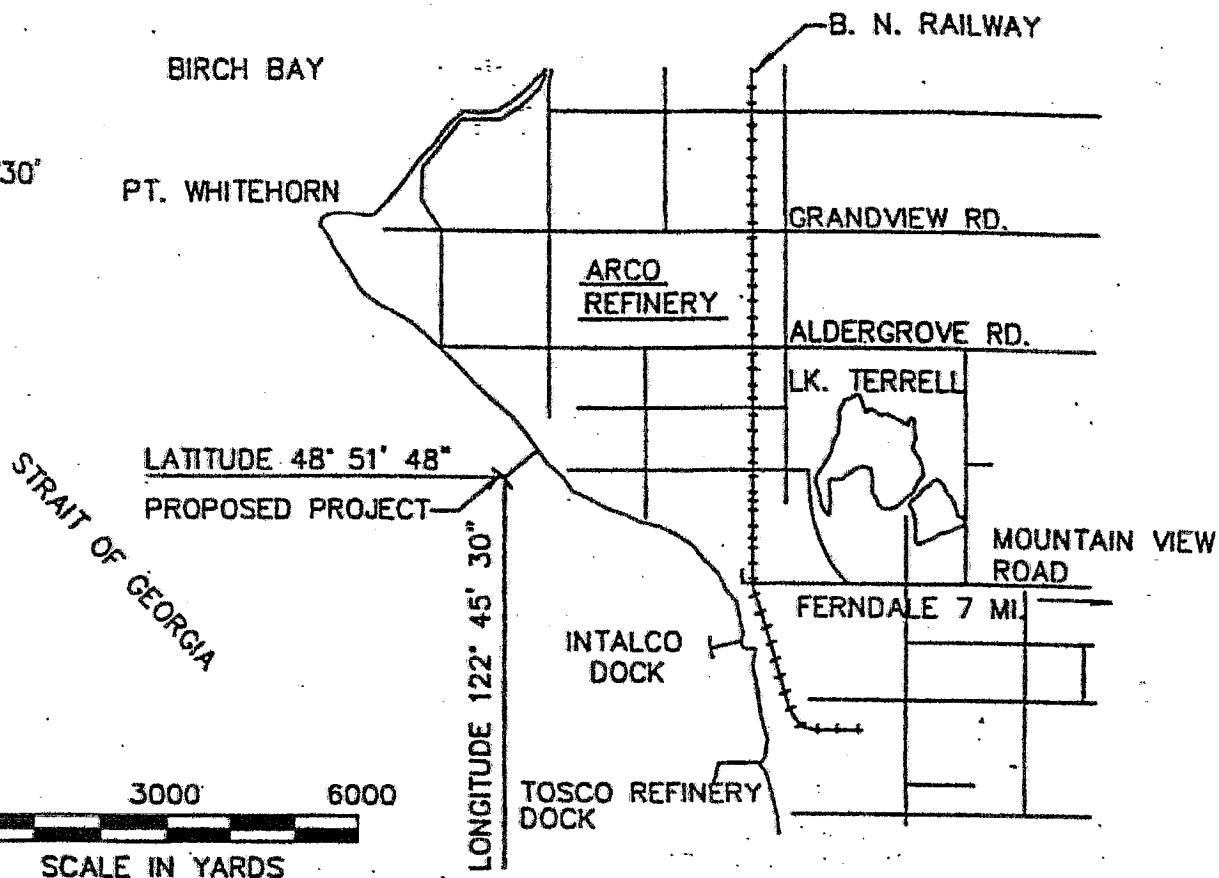
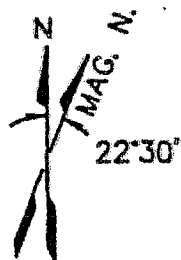
DATE: 10/15/91
DATE: 1/00

92-1-00435

ENGINEERING CONTRACTOR:

ANVIL CORPORATION
BELLINGHAM, WA.

ACAD FILE #: 4116CD11.DWG
DATE: 02/03/00 13:29



NOTE:

- 1: REFERENCE: U.S.C. & G.S. CHART OF STRAIT OF JUAN DE FUCA AND STRAIT OF GEORGIA NO:6380; DATE: 6/10/72.

92-1-00435

PURPOSE: PETROLEUM PRODUCT LOADING/UNLOADING FACILITY. NO FEDERAL HARBOR LINES IN EFFECT.
DATUM: MEAN LOWER LOW WATER (MLLW)-0.00 M.O.S.
SOUNDINGS ARE IN FEET.

VICINITY MAP

ATLANTIC RICHFIELD COMPANY
PRODUCTS DIVISION
CHERRY POINT REFINERY

PROPOSED DOCK, PILING, CONNECTING TRESTLE AND DOLPHIN COMPLETION.

IN: STRAIT OF GEORGIA
NEAR: FERNDALE
COUNTY OF: WHATCOM; STATE, WA
APPLICATION BY: ARCO PRODUCTS CO.
CHERRY POINT REFINERY

SHEET 1 OF 10
REV 1

DATE: 10/15/91
DATE: 1/00

ENGINEERING CONTRACTOR:
ANVIL CORPORATION
BELLINGHAM, WA
ACAD FILE #: 4118CDD4.DWG
DATE: 01/31/00 07:50

